Second Annual Report

of the

PRIEST RIVER EXPERIMENT STATION

District One.

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-By-

D. R. Brewster-

Forest Assistant in Charge.

Priest River, Idaho.
January 1, 1913.

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PROJECT - PRIEST RIVER - F-sms-1.

METHODS AND SEASONS FOR SOWING AND PLANTING.

Western white pine
Western larch
Western yellow pine
Douglas fir

OBJECT

To determine the best season and methods for sowing and planting and the best kind of stock to use on various sites.

WORK DONE PRIOR TO DECEMBER 31, 1912

Experiments with one or more of the above species have been started along the following different lines:

1. Comparison of planting and sowing by different methods.
2. Comparison of fall and spring for sowing and planting.
3. Comparison of planting sites.
4. Comparison of different ages of stock.
5. Comparison of root-pruned and unpruned planting stock.

Unless otherwise mentioned, all work was done on plots 50 feet square, spots or plants spaced 5 feet by 5 feet.

Three different planting sites have been used in these experiments, known as Blocks A, B, and C. In order to avoid repetition a detailed description of each of these sites will be given and in the further discussion reference will simply be made to the block letter.

BLOCK A

This area is part of what is known as Benton Flat.

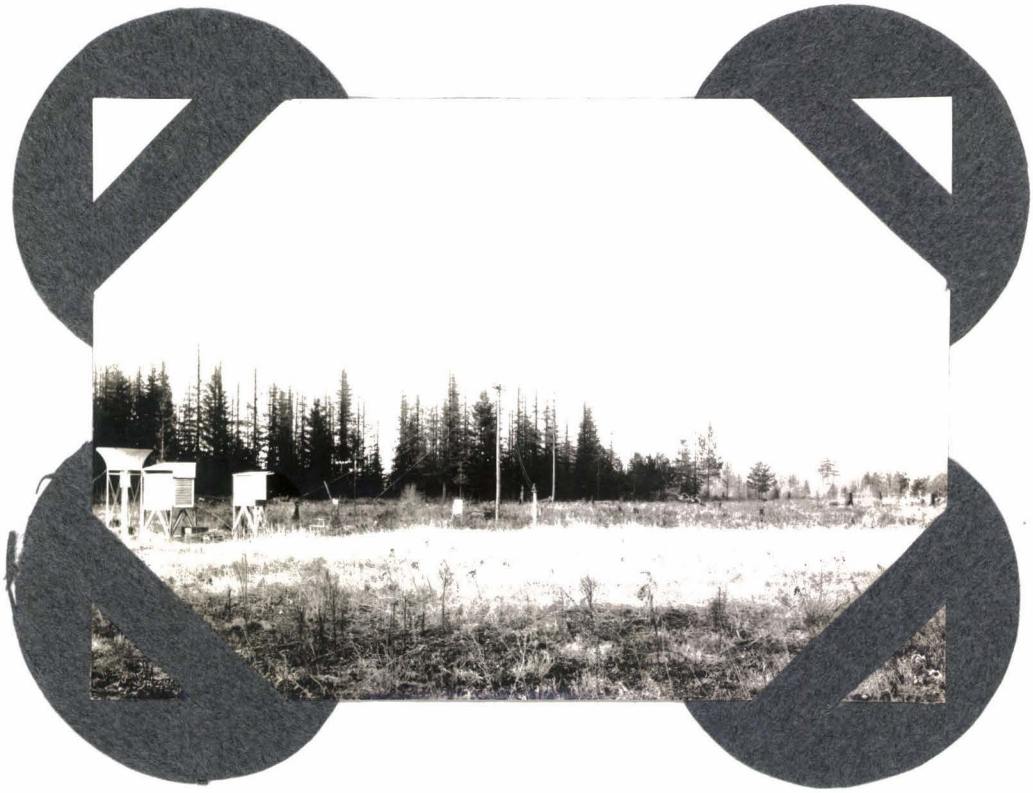

PLATE NO. 35

Project F-sms-1

General view of Block A planting site with Control Meteorological Station No. 3 on left. Looking down the row of eighteen 50x50 plots, showing that only shrubs and brush were cleared away and that a heavy growth of herbage was left on the ground undisturbed. Small patch of rye sowed on plowed nursery ground fall of 1911, shown in foreground.

It is a level silt and gravel bench at the mouth of Benton Creek valley and is presumably composed of the settlings in an eddy or backwater of the large glacial lake or stream which once occupied the Priest River Valley trough. A deep deposit of clay-like silt through which water percolates very slowly is overlaid by about ten feet of a mixture of gravel, sand, and silt which is quite porous, takes water very readily, and has poor capillary properties. It is consequently well drained but relatively dry when precipitation is light.

The elevation is 2360 feet. The ground was burned about fifty years ago and has slowly restocked itself with yellow pine, larch, spruce, Douglas fir, lodgepole and white pine. The spruce and white pine are both stunted and show frequent injury to terminal shoots, indicating unfavorable conditions for these species. Larch, yellow pine, Douglas fir, and lodgepole make excellent growth on the area and it is considered a favorable site for them. Experiments with Douglas fir, yellow pine, and larch have been started here and several exotics have been tried. Meteorological Station No. 3 is located in the center of the block. Plates 32 and 35 give a good idea of Block A and show the extent of the clearing for experimental plots. The scattering trees and shrubs were removed but the ground cover of herbs and annuals was left undisturbed.

BLOCK B.

This block is at an elevation of 2500 feet on the southwest exposure of a spur running out from the main ridge which forms the north boundary of the Benton Creek watershed. It is

situated about 1/8 mile northeast of and 140 feet higher than Block A which lies at the foot of this spur as shown in Plate 32. Although situated rather close to Block A, Block B is quite different in character of soil and meteorological factors. It is characteristic of large areas of open southerly slopes covered with brush and scattered yellow pine and Douglas fir of various ages. These slopes have been burned over and are slowly and in most cases only partially reproducing.

Block B contains one large and flourishing yellow pine almost in its center which has frequently borne good seed crops as shown by the cones scattered at its base. During the fifty years since the tract was burned, however, only a very few scattered young trees have been able to establish themselves. This is also true of Douglas fir, of which there are four good seed trees on the block, all of which have borne quantities of cones, although more reproduction is found of this species, particularly as the exposure of the ridge becomes more easterly. The yellow pine cones are very carefully gathered and hoarded by the squirrels so that very little of the seed is liberated naturally. A great many of the young trees are found in bunches of from two to six and on characteristic "squirrel cache" ground leading to the assumption that most of the reproduction is the result of squirrels burying cones and then forgetting them. This is a rare occurrence, as shown by the small number of seedlings. Under these circumstances it is thought that sites of this kind are well worth artificial reforestation if it is desired to secure a stand of timber some time within the next fifty years.

The exposure of Block B varies from south to west and the slope is from 25 to 30 per cent. The soil is shallow and consists of a fine silt mixed with gravel and talus and with rock outcropping occasionally. It contains a little humus and has small moisture holding capacity. Plates 32 and 59 show the general character of the ground cover on this ridge in the distance and Plate 32 shows a characteristic detail. Large stools of willow, serviceberry and other bushes and shrubs are frequently encountered in planting and occupy much of the ground with their roots and shade. Between these the surface is well covered with grasses and sedges and other herbs and annuals and with frequent clumps of Artostophylos Nachistima and other trailing evergreen plants. In the experiments in this block no attempt has been made to clear the ground beyond brushing out the plot lines for surveying purposes, so that the competition from the ground cover has been unaffected except by the clearing at the hole or seed spot. Yellow pine, Douglas fir, white pine, and larch have been used here, as well as several exotics. Meteorological Station No. 2 is located on Block B as shown in Plate 58.

BLOCK C

Block C is located 1/2 mile south of Block A on what is known as the Jurgens Brothers Cutting, sale of Feb. 15, 1910, on the NW¼ of Section 34, T. 56 N., R. 4 W. B.M. The main Priest River flows through one corner of this quarter and the ground consists of a series of terraces running parallel to the

PLATE NO. 36

Projects F-sms-1 and M-c-1.

Block C planting site, Jurgens Cutting. Character of material left on ground after slash has been severely burned three times and mineral soil completely exposed. Foreground--Half acre plot planted with 2-1 white pine by slit method, 800 per acre. Location of some plants shown by small white stakes among logs. Sparse growth of annuals first season. Background--seed plot through which slash fire ran killing all white pines and some larch.

river and from 20 to 100 feet above it, each of which was once the bed of the river. There is also a ridge on the south east corner, as shown in Plate #1, running down to meet the upper terrace. Plates 40, 42, 43 under Project M-c-1 and plates 36 and 38 shown with this project shows views of Block C.

The benches or terraces are well drained except where springs and seepage points are found. The latter indicate general sub-irrigation. Between the lowest bench and the next higher one is a swampy area, the site of an old ox bow, which cuts a north and south strip through the Block.

The soil is dark reddish silt of very fine texture. It is of alluvial origin combined with top wash from the surrounding hillsides. The surface contains considerable humus and the soil has excellent moisture holding and capillary properties. The area is a very favorable site for white pine and its associated species. The 250 year old stand of timber cut from this area produced 6,178 board feet white pine, 6,781 board feet larch, and 2,484 board feet cedar per acre when mixed with considerable large hemlock.

The ground, after being cut clean with the exception of some seed plots, was burned over by broadcast slash fires from one to three times during the summer of 1911, leaving the mineral soil largely exposed and a tangle of charred logs and waste material strewn over the area as shwon in the plates. Further description of the ground cover can be obtained from notes under Project M-c-1. New growth of scattered weeds started in 1912 and furnished the only competition, which was almost

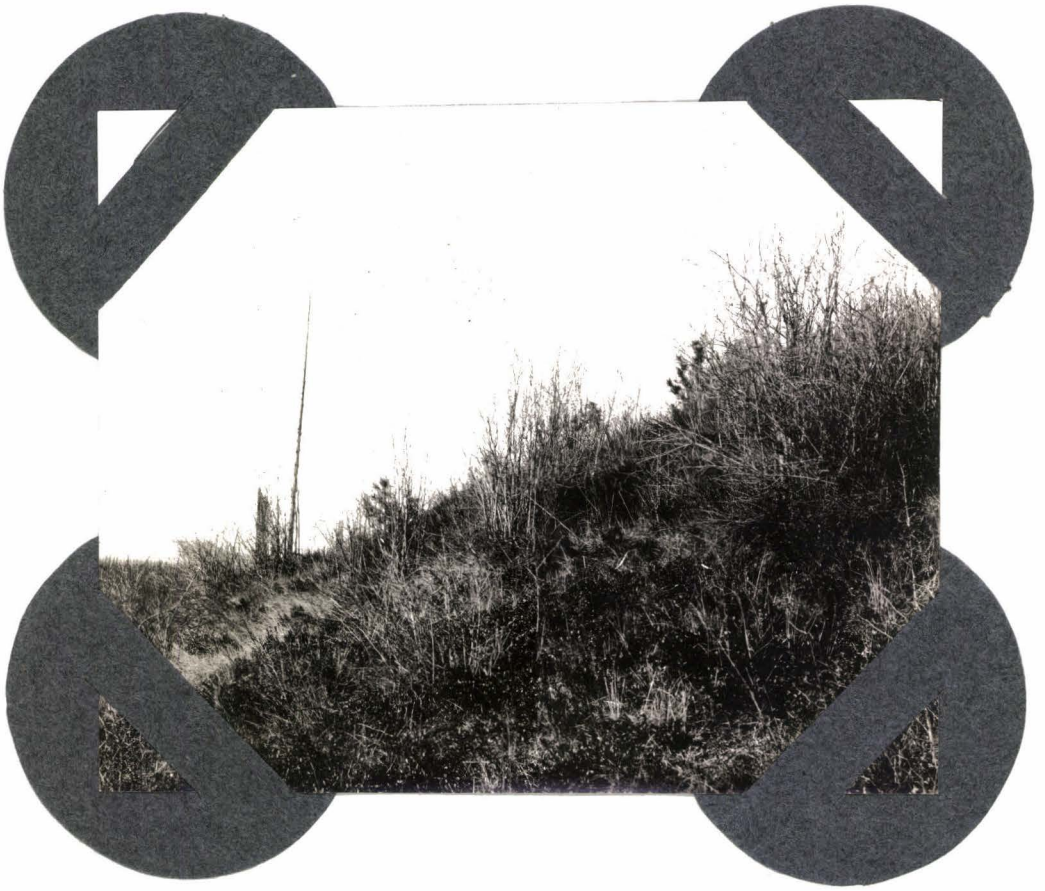

PLATE NO. 37

Project F-sms-1.

Character of ground cover on Block B planting site; -Open southwest hillside, covered with herbs, annuals and willows, serviceberry and other shrubs. Sparse yellow pine reproduction resulting in fifty years from neighboring vigorous seed trees. No clearing was done on these plots.

negligible. In 191? there will probably be enough of such plants to cover the ground fairly well and to become a factor in forestation experiments. White pine, larch, Engelmann spruce, and various species not native have been experimented with on this block. Four groups of 50" square plots have been located at different parts of the area. On these the logs have been removed for convenience.

COMPARISON OF THE THREE BLOCKS

Meteorological readings were taken on Blocks A and B continuously. A check reading of maximum and minimum air temperatures and of soil moisture was taken daily at Block C during most of August, the hottest and driest period. A physical analysis was made of a large number of soil samples from each block by means of graduated sieves and an average composition for the block computed.

TABLE NO. 1.

PHYSICAL COMPARISON OF SOILS IN THREE BLOCKS.

Block	Percent of different sizes in millimeters by wt.							
	Sand and hard balls of silt				Silt	Clay	Water	Name of Soil
	5 mm plus	3mm-5mm	2 mm-3 mm	1 mm-2 mm	½ mm-1 mm	½ mm minus	24 hrs.	
A	7.7	5.0	5.8	14.3	25.9	40.7	0.5	Sandy Silt
B	29.0	5.1	4.0	6.5	6.0	49.0	0.4	Gravel Silt
C	2.2	1.8	2.7	12.3	15.2	65.2	0.6	Alluvial Silt

Soil moisture samples taken at the surface and at six inches on the three blocks from August 15 to September 6 showed that the water content at Blocks A and B was close at all times. During dry weather Block A showed from 5 to 15 points higher and during wet weather Block B showed moisture up to 20% higher. The range of these two blocks was from 2% at Block B at the end of a dry period of eight days up to 45% at Block B in a rainy period, Block A seeking a middle course in both cases. Block C was at all times more moist than the others and held a rather even course between 20% at the driest period and 60% during rainy weather, reaching 90% once .

Block B shows the greatest drought and readiness to lose its moisture. A is a little more moist than B and more uniform. C is much more moist than either because of better water holding capacity and because the excellent capillarity keeps the surface well supplied with moisture.

The differences in air temperature at 4½ feet from the ground were not great. B, because of its sloping exposure to the sun, showed the highest temperatures, but A and C were not much less at the same periods. The minimum at night was noticeably less at A and C because of air-drainage, C being usually lowest. Soil temperatures at B were from 1 to 4 degrees F. higher than at A. The wind velocity at B was twice as great as at A, causing a great deal more surface evaporation and transpiration at B than at A. The wind at C was approximately the same as at A although no record was kept. In June and July the relative air humidity was slightly more at B than at A while

in August it was greater at A. The monthly averages were at no time more than 8% apart so that this difference is probably negligible. Precipitation was slightly greater at A during the growing season, the difference varying from nothing in June to 0.40 inches in August. The total precipitation for the year was 2.16 inches greater at A than at B, out of a total of 37.45 inches.

GENERAL CONCLUSIONS

The controlling difference between the three sites is in soil moisture. Block B, with the least soil moisture coupled with greatest transpiration, is dry and least favorable. A, with its greater rainfall and moister soil and less wind, is rather more favorable, but still relatively dry, while C has the advantage on every count and is noticeably the most moist and favorable of the three. Transpiration in itself would not be unfavorable at B if there were enough moisture present at the roots.

DEFINITIONS OF METHODS USED.

PLANTING

1. Cone Method

Tool - Mattock
Hole - 8-10" deep, earth pulverized.
Setting - With both hands, roots spread in different directions over mound or cone of earth in center of hole.
Firming - Gradually with both hands and fingers so that plant is left upright at the proper depth in the center of the hole.

2. Side of Hole Method

Tool - Mattock
Hole - 6-8" wide; 6-12" deep, earth pulverized.
Setting - With one hand, against straight clean-cut side of hole, in upright position.
Firming - Earth pushed into hole against root with foot and pressed firmly with sole and heel.

3. Slit Method

Tool - Mattock
Hole - Slit in ground made by one insertion of mattock widened to admit roots by lifting the handle.
Setting - With one hand, plant upright and roots in a downward, natural position.
Firming - With heel, done at the same time as setting.

SOWING

1. Broadcast

Seed scattered over ground by hand, covering the area once in each cardinal direction in 25 foot strips.

2. Cornplanter

25 seeds inserted just below surface with hand corn-planting machine and firmed with heel.

3. Seedspot

Ground cleared of grass and weeds and surface pulverized, space 8-10" wide, with hoe, rake, or mattock, pinch 25-30 seeds scattered with fingeres; lightly covered and firmed with foot.

I. WESTERN WHITE PINE (Pinus monticola)

The cone or careful method with 2-1 white pine transplants was tried in the fall, 1911, and spring, 1912, on two groups of Block C. The slit and side of hole methods as well as the cone method were tried in the fall of 1912. In the latter work, ⅛ acre plots were used instead of the regular 50 foot square plots and a spacing of 6 3/4 x 8 (800 per acre) used, in order to get a better comparison of time required.

White pine seed was sown broadcast, in unprepared seedspots with cornplanter, and in seedspots prepared with hoe, rake, or mattock. The work was done in Block C, on 50 foot plots in the fall, 1911, and spring, 1912, and on ⅛ acre plots in the fall, 1912.

A comparison between root-pruned and unpruned 2-1 white pine was started in Block C in the fall, 1912. An experiment to compare different ages of white pine planting stock was also started in October, 1912, using 1-1, 2-1, and 2-1 stock. Other ages will be added as opportunity offers.

The seedspot and cornplanter plots sown in the spring of 1912 were duplicated on adjacent plots with seed which had been soaked in a 2% solution of formaldehyde. These latter plots were failures and were not tabulated since it was later learned that formaldehyde has an injurious effect on seed germs.

Two 50 foot lots were planted in the spring, 1912, with 50 2-1 white pine and 5- 1-1 larch alternately, in group I, C, and in Block B. Table No. 2 shows the season's results.

RESULTS OF 1912 SEASON, PLANTING AND SOWING WHITE PINE

TABLE NO. 2

Method Used	Season Started	Location Used	Amount Used: On plot	Amount Used: Per A.	Living in October: On plot	Living in October: Per A.	%Germin.
Planted	Fall	C-II	100	1700	45	765	
Planted	Fall	C-III	100	1700	62	1054	
Planted	Spring	C-II	100	1700	79	1343	
Planted	Spring	C-III	100	1700	51	867	
Planted	Spring	C-I	50	850	28	562	
Planted	Spring	B-19	50	850	46	1564	
Seedspots	Fall	C-III	1¼ oz	1.33#	33	561	3
Seedspots	Spring	C-III	"	"	7	119	0.6
Cornplanter	Fall	C-II	"	"	9	153	0.7
Cornplanter	Spring	C-II	"	"	3	51	0.2
Broadcast	Fall	C-II	7½ oz	8.0#	1	17	0.0
Broadcast	Fall	C-III	"	"	0	0	0.0
Broadcast	Spring	C-II	"	"	2	34	0.0
Broadcast	Spring	C-III	"	"	2	34	0.0

COMPARISON OF AVERAGE NUMBER ON PLOTS

Method	Seasons: Fall	Seasons: Spring
Planting	54	69
Seedspots	33	7
Cornplanter	9	3
Broadcast	1	2

Sites Planting

Group I, Block C - - 56%
Group II, Block C- - 62%
Group III, Block C - 57%
Plot 19, Block B - - 92%

Methods

Planting - - - - - - 64
Seedspots - - - - - 20
Cornplanter - - - - 6
Broadcast - - - - - 2

COMMENTS

a. Seasons:

Spring planting of white pine shows a slight advantage over fall planting. Stock used in the spring was from Savenac and stock used in fall was from Boulder which may have caused a slight variation. Seedspots, the most successful method of sowing, showed fall to be the better season.

b. Methods:

Sowing work was done with seed which tested 15,000 good seed per pound. This made a sowing of 1200 seeds per seedspot plot or 12 good seeds per spot and 7000 per plot broadcast. The percentage of success was figured on the number of seed sown. Planting, which averages 64 per cent successful for all sites and seasons, is clearly the best method to use for white pine. The only method of sowing which produced any results was the prepared seedspots. The labor cost of this method is about the same as of slit planting but the cost of seed is somewhat less than planting stock. It is thought that slit planting will be twice as successful as seedspots, however. The sown plots will probably show additional germination in the spring, if the rodents have not destroyed all the remaining seed. In spite of heavy poisoning in fall and spring, a large per cent of the seeds were destroyed in this way.

c. Sites:

The planting on Block C is quite uniform for the three groups. The 92% of 50 plants living at Block B is surprising, in view of the dry situation, and is hardly conclusive until checked by future work.

II. WESTERN LARCH (Larix occidentalis)

An experiment to compare the different ages of stock for field planting was started in the spring, 1912, at Block A using 2-0, 1-1, and 2-1 stock. This stock was in poor condition to begin with and growth had already started sufficiently to cause most of the first shoots to wither and to make it necessary for the plant to produce new ones from other buds. Plots were contiguous. Further ages, 3-0 and 2-2, were planted in Block C in the fall, 1912.

Larch Stock, Planted Spring 1912.

Age Class	Per cent living, October	Growth
2-0 Seedlings	76 per cent	1 3/4 inches
2-1 Transplants	42 " "	1 Inch
1-1 Transplants	29 " "	3/4 inch

For spring planting this is clearly to the advantage of the 2-0 seedlings. Our present experience indicates that spring planting is not advisable unless it can be done very early, before growth starts.

A comparison of sites is offered by the fifty 2-1 trees planted alternately with white pine in Blocks B and C in the spring.

Block A - - - 42 per cent living
Block C - - - 30 " " "
Block B - - - 16 " " "

The relative success is perhaps partially explained by the fact that there was considerable difference in the size and condition of the trees and that Block A, which was planted first, probably received a larger number of the first class trees. The poor showing at Block B was to be expected as larch is not found there naturally.

III. WESTERN YELLOW PINE (Pinus ponderosa)

Yellow pine 1-1 transplants were planted by the cone method at Block A in fall, 1911, and spring, 1912, and at Block B in the spring, 1912; and by the slit method, Block B, fall and spring. The side-of-hole method was tried in the fall, 1912, in connection with the age of stock work. Yellow pine seed was sown broadcast, and with cornplanter at Blocks A and B in fall and spring, broadcasting at Block B being done on harrowed ground; in seedspots at Block A fall and spring and at Block B in the spring, 1912. Table No. 4 gives results of sowing and planting for the season.

1-0, 2-0, 1-1, and 2-1 planting stock was used at Block A in the spring, 1912, to compare ages of stock. To compare the different ages on two sites, 1-0, 2-0, 1-1, 2-1, and 1-2 yellow pine stock was planted at Block B in the fall, 1912, using the side-of-hole method. There is less difference between this method and the cone method on this site because the soil is so shallow and rocky that the cone method has to be somewhat modified. The difference is mainly in the fact that covering and firming is done with the foot in the side-of-hole method and with the hands (difficult in rocky soil and of doubtful value) in the cone method.

Comparison of Ages of Stock Planted in Spring Block A, Cone Method

100 Seedlings	81% living October	3/4"	Average Growth
2-0 Seedlings	68% " "	1½"	" "
1-1 Transplants	79% " "	1½"	" "
2-1 Transplants	43% " "	1½"	" "

The success of 1-0 stock is surprising and probably due partially to the unusually wet season of 1912. The low record of 2-1 transplants is difficult to account for and should be checked.

RESULTS OF 1912 SEASON, SOWING AND PLANTING YELLOW PINE

TABLE NO. 3

Method Used	Season Started	Location Used	Amount used: On plot	Per A.	Living in October: On plot	Per A.	% Germin.
Planted, cone	Fall	Bl. A	100	1700	48	816	
Planted, cone	Spring	Bl. A	100	1700	81	1377	
Planted, cone	Spring	Bl. A	100	1700	77	1309	
Planted, cone	Spring	Bl. B	100	1700	23	391	
Planted, slit	Fall	Bl. B	100	1700	42	714	
Planted, slit	Spring	Bl. B	100	1700	36	612	
Broadcast, har.	Fall	Bl. A	6-2/3 oz	7#	28	476	1.5%
Broadcast, har.	Spring	Bl. A	" "	"	18	306	1.0%
Broadcast	Fall	Bl. B	" "	"	1	17	0.05%
Broadcast	Spring	Bl. B	" "	"	0	0	0.0%
Seedspot	Fall	Bl. A	3 "	3.3#	63	1071	7.4%
Seedspot	Spring	Bl. A	" "	"	117	1989	13.7%
Seedspot	Spring	Bl. B	" "	"	89	1513	10.4%
Cornplanter	Fall	Bl. A	" "	"	12	204	1.4%
Cornplanter	Spring	Bl. A	" "	"	30	510	3.5%
Cornplanter	Fall	Bl. B	" "	"	10	170	1.2%
Cornplanter	Spring	Bl. B	" "	"	3	51	0.4%

COMPARISONS OF AVERAGE NUMBER ON PLOT

Seasons

Method	Fall A	Fall B	Spring A	Spring B
Planted	48	42	79	30
Seedspot	63	--	117	89
Cornplanter	12	10	30	3
Broadcast	23	1	18	0

Methods and Sites

Method	Block A	Block B
Planted, cone	69	23
Planted, slit		39
Seedspot	90	89
Cornplanter	21	7
Broadcast	23	1

COMMENTS

1. Seasons. Spring planting makes a much better showing than fall planting in Block A, but in Block B fall work has a slight advatnage. This is probably directly due to the difference in sites, Block B being relatively dry in the spring and Block A moist because of soil and exposure and because the snow goes off Block B a month earlier than at Block A. In the sowing work, Block A shows spring to be best for seedspots and cornplanter and fall slightly better for broadcasting. Block B had fair results with seedspots in the spring but no fall plot for comparison; practically no results with broadcast or cornplanter either season.

2. Methods. 1900 seeds were sown broadcast per plot and 850 per plot in seedspots. The comparison between slit and cone planting favors the slit method at Block B, perhaps because the soil is less disturbed and dried out by exposure to the air, where using the slit method. Although the seedspot sowing gives a higher number per plot, these seedlings are less well distributed than the transplants and will probably show a greater mortality during the next season. Considering that the cost of seedspot sowing is not very much less than slit planting, the latter would appear the surest and cheapest method of securing results.

The broadcasting and cornplanter work was partially successful at Block A but a failure at Block B which would indicate that these methods should be used with yellow pine only on the more favorable sites. It is known that rodents destroyed a

large quantity of the seed sown, in spite of heavy poisoning in the fall and spring, before sowing. The greater success of prepared seedspots over cornplanter seedspots is partially due to the greater ease with which all of the cornplanted seeds are found. One or two out of 15 seeds sown in a prepared spot often escaped the rodents, because scattered over greater space and buried one in a place, while the rodents could almost invariably locate the single pile of seed in the cornplanter spots. Neither did the rodents have difficulty in locating the seed sown broadcast, as indicated by close examination of the surface for seed and hulls. Unless some efficient method of rodent eradication can be provided, our results indicate that the prepared hand-sown seedspot is the only method of sowing yellow pine that can be depended upon for satisfactory results, on areas where rodents are troublesome. An effort will be made next spring to find tools and methods which will reduce the expense of this method to a minimum.

3. Sites The two sites, Blocks A and B, have been discussed under seasons and methods. Block A shows much the best results.

III. DOUGLAS FIR (Pseudotsuga taxifolia)

Experiments in Douglas fir have been initiated at Blocks A and B similar to those with yellow pine, except that 2-1 stock was used for planting in fall and 2-0 in the spring as no 2-1 was available. Following is a synopsis of the work started:

Block A - Fall - planting (cone method); cornplanter, broadcast.
Spring - " " " " "
Block B - Fall - " (slit method); " "
Spring - " (slit and cone methods), cornplanter, seedspots with hoe, and broadcast.

RESULTS OF 1912 SEASON, SOWING AND PLANTING OF DOUGLAS FIR

TABLE NO. 4.

Method Used	Season Started	Location Used	Amount used On plot	Amount used Per A.	Living in October On plot	Living in October Per A.	% Germin.
Planted, cone	Fall	A	100 2-1	1700	87	1479	
Planted, slit	Fall	B	100 2-1	1700	72	1224	
Planted, cone	Spring	A	100 2-0	1700	83	1411	
Planted, slit	Spring	B	100 2-0	1700	59	1003	
Planted, cone	Spring	B	100 2-0	1700	36	612	
Seedspots	Spring	A	1-5/6 oz	2#	413	7021	13.0
Seedspots	Spring	B	" "	"	164	2788	5.1
Cornplanter	Fall	A	" "	"	135	2295	4.2
Cornplanter	Fall	B	" "	"	107	1819	3.3
Cornplanter	Spring	A	" "	"	57	969	1.8
Cornplanter	Spring	B	" "	"	4	68	.1
Broadcast, har.	Fall	A	5-2/3 "	6#	2	34	.02
Broadcast	Fall	B	" "	"	0	0	0.0
Broadcast, har.	Spring	A	" "	"	132	2244	1.3
Broadcast	Spring	B	" "	"	0	0	0.0

COMPARISON OF AVERAGE NUMBER ON PLOT

Seasons

Method	Fall A	Fall B	Spring A	Spring B
Planting	87	72	83	48
Seedspot			413	164
Cornpltr.	135	107	57	4
Broadcast	2	0	132	0

Methods and Sites

Method	Block A	Block B
Planting, slit		65
Planting, cone	85	36
Seedspot	413	164
Cornplanter	96	56
Broadcast	67	0

COMMENTS

1. Seasons. Fall planting gave best results, slightly better at A and markedly better at B. This may be due in part to the fact that 2-o stock was used in the spring and 2-1 in the fall, owing to the fact that no 2-1 was available for spring use. Even allowing for this, the results favor fall planting of Douglas fir on southerly yellow pine sites, probably because of the greater soil moisture at that time and the earlier start which the plant can make in the spring. No comparison is possible for seedspots but the cornplanter work succeeded best in the fall and the broadcast better in the spring. Broadcasting was a failure both seasons at Block B, probably due to dry surface conditions and to rodents which were also responsible for destroying a large amount of the seed in seedspots and cornplanter work.

2. Methods. Both slit and cone planting was tried at Block B, the slit method showing much the better results, due as in yellow pine to the fact that the soil was disturbed less. 3200 good seeds were sown in seedspots and 10,000 in broadcast work, per plot. The seedspots in the spring at both Blocks made an excellent showing and unless there is heavy mortality later, this method is the best and cheapest method of securing a full stocking, particularly on sites that are at all favorable. It is thought that Douglas fir seeds are less attractive to the rodents or less easily found than yellow pine, accounting for the greater success by these methods. Also, more seed was sown per spot of Douglas fir than of yellow pine. Our experience leads to the conclusion that in all seedspot work, from 25 to 30 good seeds should be sown per spot in order to provide for rodents, damping off, and mortality of one and two

year old seedlings and still leave a full stocking. The spring broadcast work at Block A in which the seeds were first sown and then harrowed in made a much better showing than the fall work in which the harrowing was done before sowing. If such preparation was possible, broadcasting on harrowed ground could be considered a fair method on favorable sites, although the seedlings are apt to be bunched in spots and less well distributed over the area.

3. Sites All of the work at Block B was much less successful than at Block A, demonstrating that Block B is a less favorable site for the species and more difficult to reforest. Douglas fir succeeded better at the Block B site than did yellow pine, however, both in sowing and planting.

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COMMENTS ON THE WORK AS A WHOLE

1. Methods. On the whole, planting has made a better or equally as good a showing as any of the methods of sowing, considering distribution and number of surviving trees. In the case of yellow pine and Douglas fir, sowing prepared spots has made an excellent record for the first season and it will be interesting to note the second year mortality. If the latter is not large, the prepared seedspot can be considered a safe and efficient method of securing a restocking. If the cost can be reduced appreciably below that of slit planting, it will be possible to consider seedspot sowing as a practicable and desirable method to use on a great many areas, particularly those which are relatively more favorable.

Results obtained with unprepared cornplanter seedspots are not very encouraging. With the same amount of seed sown per spot, the prepared hand-sown seedspots produced eight times as many Douglas fir and four times as many yellow pine seedlings as did the cornplanter seedspots on the same site and in the same season. The hand-sown spots produced a good stocking while the cornplanter spots produced only about 25% of a stand, or less. When 25 or 30 seeds are deposited in a single heap by the cornplanter they are not only much easier for the rodents to find and to totally destroy, but they are so close together as to seriously interfere with one another in sprouting and growing. In this way all of the seedlings are more or less weakened and if damping off gets in at the it makes short work of the entire number in the spot.

This phenomenon was noticed in a number of cases with Douglas fir and yellow pine cornplanter spots. A good germination would be secured of six or eight seedlings in the spring, all of them crowded together in a line an inch or two long, and in many cases touching each other. Two or three weeks after germination, damping off would attack one or two and within a week all would be killed. In the case of the hand-sown spot, however, the seedlings were often six or eight inches apart and although damping off frequently took one or two, it seldom cleaned out the spot, because of the sturdier growth and greater separation. Other things being equal, differences of this kind are the major factors in securing or not securing a stand. Further work is needed in determining the cheapest method of sowing in prepared spots.

The poor success which attended the broadcast work except in the case of the harrowed plot of Douglas fir leads to the belief that this is the most wasteful and least dependable of all the methods. The large amount of seed necessary usually brings the cost equal to or greater than that of planting and the results obtained are almost negligible in most cases. It required a sowing of four good seeds per square foot on level moist ground in a favorable season, when the seed was harrowed into the ground by crossing the area in two directions, to secure a stand of 2250 per acre, poorly distributed over the area in dense little groups. This was Douglas fir, which seems to escape the rodents better than other species. It is, therefore, apparent that seed of this and other species should be sown at least as thickly as this on average unprepared sites. Such a density of sowing would mean from 15 to 35 pounds of yellow pine, from 6 to 10 pounds of Douglas fir, and from 8 to 12 pounds of white pine per acre. From the standpoint of cost alone, this would be prohibitive, compared to planting or seedspot work.

In planting work, especially on unfavorable sites, our results thus far favor slit planting as opposed to the more careful cone planting. It is felt that the slit and side-of-hole methods will therefore prove at least as satisfactory as the cone method and will be desirable in most cases on all sites because considerably cheaper. The difference in cost is largely due to the substitution of foot work for hand work in setting and firming the plant and it is apparent that the foot work, if carefully done, can be made as efficient as hand work. Further comparisons

of the three methods should be made on a large scale as a check.

2. Seasons. The season is a more important factor in sowing than in planting. In either case, the work should be done at the time in the season when the surface soil is the moistest. At the Experiment Station this is immediately after the snow goes off in the spring and in October and the first half of November in the fall. The time will vary from year to year both as to date and length of the period. On exposed south slopes, such as Block B, it is frequently impossible to do the work early enough to take advantage of the most favorable time in the spring, as the snow goes off during March and the ground has become fairly dry in April in spite of frequent showers. In such a case, fall planting and fall sowing or late winter sowing on the snow in February or March, is recommended.

3. Sites. Sites have been discussed in connection with the different species sufficiently to show that Block C is the most favorable, Block A intermediate, and Block B relatively unfavorable. In further work a comparison of these sites with other exposures in the vicinity of the Station would be valuable.

WORK PLANNED FOR 1913

1. White Pine

Spring a. ½ acre plots to be planted by slit, side-of-hole, and cone methods to compare with last fall's work. Various tools such as the ax and adze will be compared with the mattock.

b. If method of stimulation is devised, stimulated and untreated seed will be sown in ½ acre plots, in prepared

seedspots and with cornplanter, spots to be both protected and unprotected from rodents. Different methods of making seedspots will be compared.

c. All the age classes obtainable will be planted by side-of-hole method and record made of conditions of stock.

d. Planting will be tried on several new sites, particularly brush-covered, burned hillsides, not reproducing, of different exposures and degrees of slope.

Fall a. Stimulated and untreated seed will be sown by cornplanter and seedspots in protected and unprotected spots if the spring work is not sufficiently conclusive.

b. Planting on different sites and by different methods will be continued as suggested by the results of the 1913 season in previous experiments along this line.

2. Western Larch

Spring a. Seeds will be sown broadcast, in seedspots and by cornplanter in Blocks A and C, seedspots to be both protected and unprotected.

b. If stock is obtainable, further spring planting of different age classes will be tried as early as plants can be obtained.

Fall a. The spring sowing work will be duplicated.

b. If further fall planting is thought necessary after the season's results are known, this will be done.

3. Yellow Pine

Spring a. Prepared seedspots and cornplanter seedspots will be sown, both protected and unprotected from rodents, to determine the value of the two methods and the effect of rodents, at

Blocks A and B.

b. 1-0, 2-0, 1-1, 2-1, and 1-2 stock will be planted at Block B to compare with similar work last fall.

c. Planting methods, slit, side-of-hole, cone and possibly others will be tried at Blocks A and B and different tools used such as axe and adze. If space permits this will be done on ¼ acre plots so that time and cost can be compared.

Fall Any further work which is suggested by the summer's results will be started in the fall.

4. Douglas Fir

No work was done with this species in the fall of 1912 and it is planned to give it a relatively small place in future work and to concentrate on the more valuable white pine and yellow pine which are the species which will be largely planted in this District west of the Divide.

Spring a. Whatever age classes are obtainable will be planted at Blocks A and B by the side-of-hole or slit methods, or both.

b. Further comparisons will be made of seedspots, prepared and cornplanter, both protected and unprotected to determine the effects of rodents, and make a further comparison of methods.

Fall Nothing is at present planned with Douglas fir for next fall although results of the season may suggest something.

5. Other Species and Miscellaneous

a. If stock is obtainable, a comparison of sites may be made for Engelmann spruce planting, possibly in mixture with white pine or larch.

b. Further attempts will be made to poison rodents

in the spring before sowing, with different kinds of poison.

Lack of time has prevented anything but a rough outline of next season's work and a detailed working plan will be prepared before the season opens which may make various changes in the above outline.

COSTS

The cost of clearing plots in Blocks A and C and of surveying and brushing the lines of plots in Block B have been charged against this project, making the charge relatively heavy for the first season. Future work will be largely done on uncleared land so that the cost of clearing will be lighter during the next season.

Cost to December 31, 1912 - - - - - - - -$398.94
Estimated cost in 1913 - - - - - - - - - 200.00
Estimated cost to completion - - - - - - ?

PROJECT - PRIEST RIVER - F-sms-2.

EXPERIMENTAL INTRODUCTION OF EASTERN, WESTERN AND FOREIGN SPECIES NOT NATIVE TO MONTANA AND IDAHO

OBJECT

To determine the possibilities of various eastern, western and foreign species for use in forestation work in District 1, west of the Continental Divide.

WORK DONE PRIOR TO DECEMBER 31, 1912

1. Fall of 1911. Norway spruce, sugar pine, basswood, white ash planted and shagbark hickory seed sown, Blocks A, C.

2. Spring of 1912. Planted red oak, burr oak, black walnut, white elm, hard maple, black locust, shagbark hickory, pignut hickory, white ash, eastern white pine, Norway pine, incense cedar, Scotch pine, Austrian pine, European larch.

3. Fall of 1912. Planted Japanese larch, big tree.

4. Raised in Nursery - 1912. Catalpa, soft maple, white elm, black locust, honey locust, green and white ash.

5. Sowed in Nursery, Fall, 1912. Butternut, black walnut, Japanese walnut, black oak, black cherry, hackberry, hazelnut.

6. Have on Hand for Spring Sowing. White birch, yellow poplar, boxelder, cucumber tree, Oregon alder, broadleaf maple, white ash, Norway maple, hard maple, tupelo gum, Jeffrey pine. Other species will be obtained before spring.

7. Obtained from 10 to 25 of the following species from office of the Agricultural Explorer, spring of 1912, and

PLATE NO. 38

Planted plot on Block C, Jurgens Bros. Cutting.

Projects F-sms-2, Introduction of species not native.

Plot planted alternately with 5 year old Pinus strobus and 1 year old Quercus rubra, spacing 5x5. Shows character of ground cover after removing charred logs. Slash was burned once leaving considerable unburned duff and litter. Heavy stand of white pine, hemlock, cedar, and larch in background on east side of cutting.

tried them in the hardwood nursery near creek:

10 of S.P.I. No. 24338, Pinus peuce, (raised Washington)
25 " 24418, Salix babylonica, (Chico, Cal.)
10 " 20137, Eucomia ulmoides " "
25 " 20414, Fraxinus sp. " "

In several cases, two, three, and four different species were planted on the same plot so that the effect of one on the other could be seen, as well as their adaptability to the climate. The different kinds were so combined that shade bearers and light demanders were planted in mixture as far as possible. The limited number of species and the larger proportion of light demanders made it necessary to mix two light loving species in the same plot in some cases. Thus the following combinations were made up, planted alternately in the rows:

Location	Most Tolerant	Least Tolerant
Plot 18 - B	Pinus resinosa	Pinus strobus
" 17 - B	Quercus rubra	Quercus macrocarpa
" 2-I-C	Acer saccharum	Juglans nigra Hicoria ovata
" 3-I-C	Pinus strobus	Quercus rubra
" 4-I-C	Acer saccharum	Fraxinus americana
" 5-I-C	Quercus macrocarpa	Juglans nigra
" 6-I-C	Ulmus americana	Robinia pseudacacia
" 7-I-C	Pinus strobus	Hicoria glabra Pinus resinosa
" 17-I-C	Quercus rubra	Robinia pseudacacia
" 3-IV-C	Fraxinus americana Acer saccharum	Quercus rubra Ulmus americana

Table No. 1 shows the results of the 1912 season.

PROJECT - PRIEST RIVER - F-ems-2.

TABLE NO. 1--PART ONE.

RESULTS OF 1912 SEASON, VARIOUS SPECIES NOT NATIVE; PLANTED BY MOST CAREFUL CONE METHOD.

Species Used	Source	Location	Date Planted	Age of Stock	Length in Inches: Top	Root	General Condition	Soil Moisture	Number Planted	Per Cent Alive: October-1912	Growth-1912 Range	Growth-1912 Average	REMARKS
Picea excelsa	Wind River Nursery	C-III-2	11-20-11	2-0	1½"	4½"	Fair	Moist	100	70	3/4-2"	1½"	Frozen in transit
Picea excelsa	" " "	A-15	11-20-11	2-0	1½"	4½"	Fair	Moist	100	85	1-2"	1½"	Frozen in transit
Pinus lambertiana	Shasta N. F.	C-III-1	11-20-11	1-1	3"	8	Fair	Moist	100	0	0	0	Frozen in transit - all died.
Pinus lambertiana	" " "	A-33	11-21-11	1-1	3"	8	Fair	Moist	100	0	0	0	" " " " "
Fraxinus americana	Hill, Illinois	C-II-4	11-20-11	2-0	4"	8	Good	Moist	100	87	1½-3½"	2½"	29 replanted May 25, 1912.
Tilia americana	Hill, Illinois	C-II-3	11-20-11	1-0	4	8	Fair	Moist	100	6	½-2"	3/4"	Some injury by surface fire.
Hicoria ovata	Southern Minnesota	C-II-8	12- 1-11	Seed			Good	Moist	100	spots 87 spots 193 plants	1-4"	2½"	Three nuts in spot; 1-2" deep
Pinus austriaca	Boulder Nursery	A-34	5-10-12	1-1	2-4	3-6	Poor	Moist	100	82	1-2"	1½"	Rodents killed ten
Larix europea	Hill, Illinois	A-46	5-20-12	2-0	4-8	8-12	Fair	Medium	100	52	2-3"	2½"	Sprouted while heeled in; roots dry in transit
Pinus sylvestris	Boulder Nursery	A-32	5-15-12	1-1	1-3	4-7	Poor	Moist	100	70	1-2"	1½"	Rodents killed five
Pinus resinosa	Minnesota N. F.	A-16	5-15-12	1-0	1-2	4-6	Good	Moist	100	89	½-3/4"	5/8"	Rodents killed seven
Pinus resinosa	" " "	B-18	5-27-12	1-0	1-2	4-6	Good	Moist	50	82	½-½"	3/8"	
Pinus resinosa	Mich. Agr. College	C-I-1	5-20-12	2-3	10-18	8-15	Fair	Moist	100	81	1½-4½"	2½"	Roots dry in transit
Pinus resinosa	" " "	C-I-7	5-28-12	2-3	10-18	8-15	Fair	Moist	25	72	1½-4"	2½"	Roots dry in transit
Libocedrus decurrens	Shasta N. F.	A-17	5-29-12	1-0	1-3	2-5	Good	Medium	100	95	1-2"	1½"	Arrived in good condition
Quercus rubra	Hill, Illinois	B-17	5-27-12	1-0	12-15	12-15	Fair	Medium	50	28	0-½"	"	Dry site
Quercus rubra	Mich. Agr. College	C-I-3	5-24-12	2-0	12-18	15-20	Good	Moist	50	84	1-5"	3½"	
Quercus rubra	" " "	C-I-17	5-25-12	2-0	12-18	15-20	Good	Moist	50	96	2-6"	4"	
Quercus rubra	" " "	C-IV-3	5-27-12	2-0	12-18	15-20	Good	Wet	25	100	1½-6"	3½"	Swampy site

TABLE NO. 1.-PART TWO.

Results of 1912 Season, Various Species Not Native; Planted by most careful Cone Method.

Species Used	Source	Location	Date Planted	Age of Stock	Length in Inches: Top	Root	General Condition	Soil Moisture	Number Planted	Per Cent Alive: October-1912	Growth-1912: Range	Average	REMARKS
Quercus macrocarpa	Hill, Illinois	B-17	5-27-12	1-0	12-15	12-15	Good	Medium	50	74	2-6"	3½"	
Quercus macrocarpa	" "	C-I-5	5-27-12	1-0	12-15	12-15	Good	Moist	50	92	1-2"	1½"	
Pinus strobus	" "	B-18	5-27-12	2-0	2-4	3-6	Fair	Medium	50	68	½-1½"	1"	Dry site
Pinus strobus	Mich. Agr. College	C-I-8	5-24-12	2-3	12-18	10-14	Good	Moist	50	98	2-7"	4"	
Pinus strobus	" " "	C-I-7	5-28-12	2-3	12-18	10-14	Good	Moist	50	96	1½-6"	4½"	
Acer saccharum	" " "	C-I-2	5-24-12	2-0	10-15	10-15	Good	Moist	50	96	1-2½"	2"	Sprouted while heeled in
Acer saccharum	Hill, Illinois	C-I-4	5-25-12	1-0	7-10	5-8	Good	Moist	50	72	1-1½"	1½"	Sprouted while heeled in
Acer saccharum	" "	C-IV-3	5-27-12	1-0	7-10	5-8	Good	Wet	25	48	1-2"	1½"	Swampy site
Juglans nigra	Mich. Agr. College	C-I-2	5-24-12	2-0	12-14	12-15	Good	Moist	25	100	2-6"	4½"	
Juglans nigra	" " "	C-I-5	5-27-12	2-0	12-14	12-15	Good	Moist	50	100	2-7"	4½"	
Hicoria ovata	" " "	C-I-2	5-24-12	2-0	12-14	15-18	Good	Moist	25	100	2-5"	4"	
Hicoria glabra	" " "	C-I-7	5-28-12	2-0	20-30	15-25	Good	Moist	25	100	1-3"	2"	
Fraxinus americana	Hill, Illinois	C-I-4	5-25-12	2-0	7-10	5-8	Good	Moist	50	82	1-2"	1½"	
Fraxinus americana	" "	C-IV-3	5-27-12	2-0	7-10	5-8	Good	Wet	25	64	1-2½"	1-3/4"	Swampy site
Robinia pseudoacacia	" "	C-I-6	5-27-12	2-0	12-18	10-15	Good	Moist	50	96	12-36"	24"	
Robinia pseudoacacia	" "	C-I-17	5-27-12	2-0	12-18	10-15	Good	Moist	50	96	18-48"	26"	
Ulmus americana	" "	C-I-6	5-27-12	2-0	12-20	12-18	Good	Moist	50	94	11-24"	17"	
Ulmus americana	" "	C-IV-3	5-27-12	2-0	12-20	12-18	Good	Wet	25	92	10-22"	16"	Swampy site

COMMENTS

1. Species: Only one of the species tried was a total failure, sugar pine 1-1 stock from the Shasta Forest. This stock was received about November 1, 1911, during freezing weather and was frozen solid in transit. It was thawed out by heeling in the warm ground and planted November 20 and 21. All trees were dead next spring. It is thought that this freezing was a severe shock to the plants and the principal cause of their death, although other stock was frozen in much the same way and lived. The species will be tried again by raising stock from seed.

The basswood planted in the fall has few survivors. This was partly due to a smoldering surface fire which got into the rotten wood from a nearby clearing and damaged several of the plants. The species is perhaps not adapted to its site and will be tried in other locations. The balance of the different species came through the winter very well, although their adaptability cannot be proven until they have passed successfully through several more summers and winters.

Frosts early in September killed all of the summer's growth on the black locusts but did no apparent injury to the other species.

2. Sites. Norway pine seems almost equally well adapted to Blocks A, B, and C. Red oak found the dry site at Block B very unfavorable compared to Block C. Burr oak did almost as well at B as at C. Eastern white pine did fairly well at B and excellently at C.

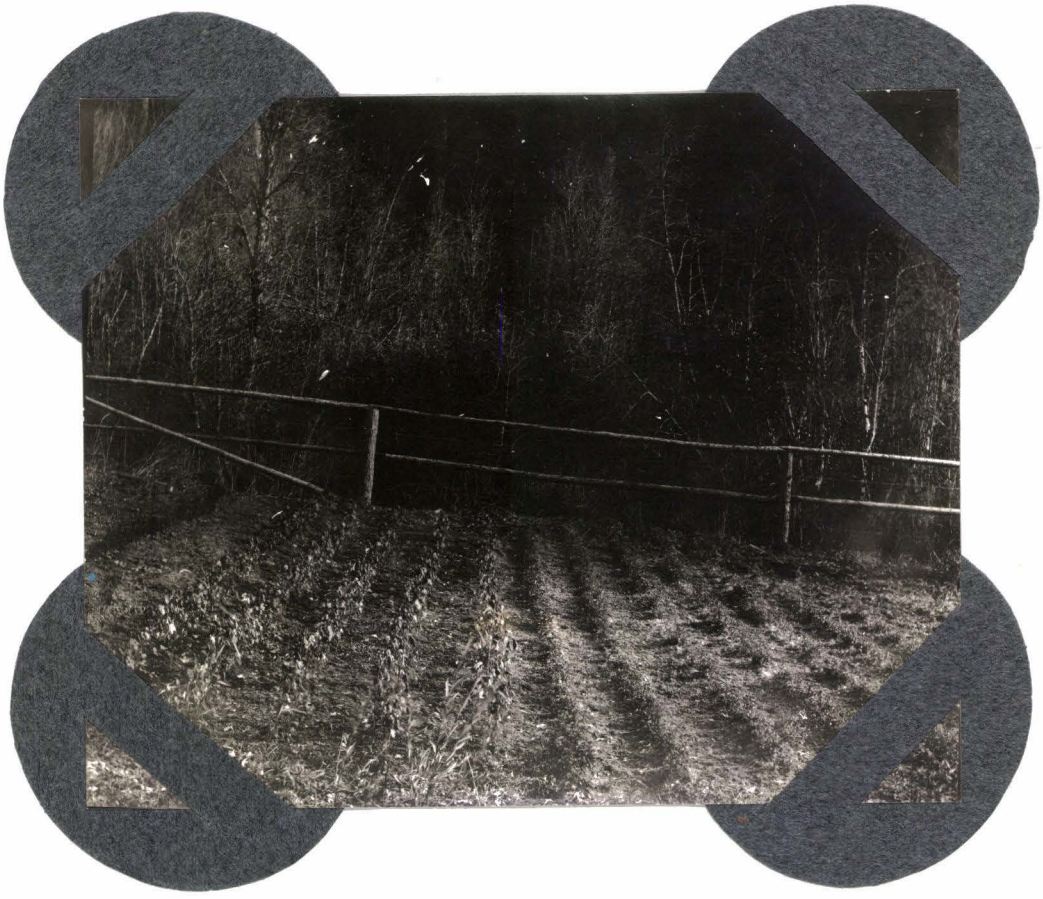


PLATE NO. 39.

Project F-sms-2.

Small hardwood nursery near Benton Creek. Cleared of alder brush (shown in background). Foreground shows soft maple (A. Saccharinum) on left and white elm (W. americanum) on right.

Species Introduced by Sowing Seed in Nurseries

1. Benton Flat Nursery: Bed No. 9 was sown June 3, 1912, with eleven different exotic conifers. It was carefully prepared and treated with nine gallons of sulphuric acid solution and divided into twelve plots 2 feet square. One plot was then sown broadcast to each species and the different plots covered from ½ to ¾ inch deep according to size of seed. Bed was mulched with two inches of leaf litter and occasional rains kept the bed moist during germination. No artificial watering was done but rains were frequent and well distributed. The bed was shaded with a 50% lath screen except in wet weather. Little trouble was noticed from damping off or blight.

2. Creek Hardwood Nursery: An area 50 feet wide and 100 feet long was cleared and plowed on alder bottom land close to Benton Creek for a hardwood nursery. It was located here principally so that water could be obtained easily. The soil was a rich black loam four inches deep underlaid by a heavy silt subsoil. It was sub-irrigated from the creek and apparently favorable for hardwoods. The only drawback was the low situation, causing poor drainage and making the ground liable to early and severe frosts.

The seed was sown in drills 18 inches apart, after being soaked 48 hours. Seed was watered daily until germination and cultivated during the season. There was more than enough rain water for the seedlings all summer. The soil was new and not in the best of condition.

Table No. 2 shows season's results, both nurseries.

PROJECT - PRIEST RIVER - F-sms-2

Table No. 2

Exotics Raised in Coniferous and Hardwood Nurseries, 1912

Species Sown	Source of Seed	Amount Sown Pounds	Number of Plants	Average Growth Inches
1. Conifers				
Pinus strobus	Superior N.F.	.145	1,800	1½
Tsuga canadensis	Mich. Ag. Col.	.06	700	5/8
Pinus taeda	N. Carolina	.104	600	2
Larix siberica	Russia	.065	10	5/8
Pinus austriaca	Europe	.095	800	1½
Juniperus californica	Kern N.F.	.20	none	
Pinus resinosa	Minnesota N.F.	.09	2,000	1
Cupressus lawsoniana	Siskiyou N.F.	.057	800	5/8
Larix europa	Europe	.088	80	1
Sequoia gigantea	Sequoia N.F.	.033	750	2
Picea sitchensis	S.W.Washington	.145	1,100	1½
2. Hardwoods				
Ulmus americana	Mich. Ag. Col.	2.00	10,000	2½
Acer saccharinum	" " "	2.00	2,000	11
Fraxinus americana	Illinois	.50	500	9
Catalpa speciosa	"	.25	200	5
Tilia americana	"	.10	none	
Platanus occidentalis	"	.10	none	
Juglans cinerea	Minnesota	25.00	7	8
Robinia pseudacacia	Colorado	.05	25	5
Gleditsia triacanthos	Kansas	.05	25	6
Fraxinus lanceolata	"	.05	20	7

Frost Injury to 1 year seedlings, observed November 16:

1. Conifers at Benton Flat Nursery.

a. Picea sitchensis. Most of terminal shoots frosted and turned brown and limp. Most of side leaves still green and turgid. Injury probably severe but not fatal.

b. Sequoia gigantea. All plants turned deep purple or reddish brown. Brown ones undoubtedly badly frosted as terminals were limp and stems soft and apparently dead. Most of plants still purple and turgid and may not be badly injured.

c. Larix europea. Deciduous and injury, if any, cannot be ascertained. Buds well developed and healthy looking.

d. Cupressus lawsoniana. About half of the seedlings quite brown and apparently badly frosted; balance purplish green with occasional brown leaves, but turgid and healthy.

e. Pinus resinosa. Uniformly green and healthy.

f. Pinus austriaca. Many tips of leaves turned brown or purple but practically all centers and lower parts of leaves still green and turgid. Injury probably small.

g. Larix siberica. Deciduous so that injury, if any, does not show. Buds well developed and healthy looking.

h. Pinus taeda. Most of leaves were purple at tips. All centers and lower parts of leaves still green and healthy.

i. Tsuga canadensis. Uniformly green and healthy.

j. Pinus strobus. Uniformly green and healthy.

2. Hardwoods at Creek Nursery: Catalpa, butternut, black and honey locusts killed back to ground; white and green ash terminals frosted; elm and maple uninjured.

WORK DONE AT THE UNIVERSITY OF MONTANA, SEASON 1912.

Twenty-eight different lots of seed, collected by the Service, comprising nineteen different species, were furnished to Professor J. E. Kirkwood of the Department of Forestry, university of Montana, at Missoula, by the District Office in the spring of 1912. Professor Kirkwood determined the number of seed per pound and made a knife test to show the quality of the seed.

Each lot of seed was divided into two samples, in most cases, equal amounts. One sample was sown under high shelter in an enclosure 8 feet high which was covered on top and all sides with lath spaced so as to give 50% shade. The other sample was sown under low shelter, in 4 x 12 beds enclosed by a tight frame one foot high covered with building paper on the sides and a continuous layer of laths on top during germination, which was later reduced to 50% shade by removing every other lath. The surface soil was a gravel silt about 1 foot deep, showing a tendency to bake but fertile when well watered. The subsoil was a deep deposit of stones and gravel with a very poor capacity for retaining moisture.

Seed was sown broadcast, lightly raked in and covered with sand to a depth of 1/8 to 1/2 inch, depending upon size of seed. Beds were sprinkled twice daily. Little trouble was experienced with damping off except with Pinus austriaca. Rodents destroyed most of the Pinus lambertiana seed before they were finally captured in steel traps.

Table No. 3 shows the results of the season's work.

Comments on University of Montana Work:

This work is really concerned with nursery investigations and study of climatic varieties as well as with what we are dealing with in this project,--the introduction of species not native to District I, west of the Continental Divide. However, it is more convenient to put all the data into one table under this project than to spread it out in three projects and the fourteen samples of native species have, therefore, been included with the seven exoticssamples.

Seven samples included in the sowing work were omitted from the table: 2 of sugar pine and one each of Abies magnifica, Juniperus californica, and Pinus flexilis because work was practically a failure; one each of green ash, honey locust, black locust because the work with hardwoods could be kept separate, making it unnecessary to increase size of the table. A summary of the hardwoods follows in Table 4.

Table No. 4 - Hardwoods at Univ. of Montana

Species	Amt.used:	In pound:	Number:	Maximum:	Average
Green Ash	4 oz.	26,332	1,200	2.5"	1.75"
Honey Locust	2 oz.	2,493	12	5.5"	4.0"
Black Locust	2 oz.	20,416	350	5.5"	3.5"

It is interesting to note that species which produced more seedlings under the high shelter are all of them adapted to dry sites: Yellow pine, Austrian pine, Blue spruce, Bigtree, and Incense cedar. The Engelmann spruce and Douglas fir from the Pacific Coast produced noticeably larger plants than did the Rocky Mountain samples of those species.

Professor Kirkwood intends to continue his observa-

tions on these seedlingsduring the next season, recording their winter hardiness and growth during the second year. At the end of that time any of the stock which will be of use to the Experiment Station in the study of source of seed or in experimental planting with native or exotic species will be available for that purpose, as it is understood that Professor Kirkwood will have no further use for most or all of it.

A number of other samples will be furnished to Prof. Kirkwood for next spring's planting as he wishes to continue the work with as many different species and climatic varieties as can be obtained. The work which he is doing will be valuable as a guide to the exotic species and the varieties of native species which will be most suitable for use in planting work on the Forests in the vicinity of Missoula. The completeness of the study will, of course, depend upon the amount of time which he is able to spend on the work and the funds which he will have available from the University for carrying on the project. The cooperation of the Service will consist merely in furnishing seed and in giving Professor Kirkwood extracts from our reports and any other available information that he may desire.

PROJECT - PRIEST RIVER - F-sms-2 - TABLE NO. 3

Season's Results - Seed Samples Sown at University of Montana Nursery, 1912

Species	Source and Year	Number in Pound	Germ. Test	No. Days Date Sown	No. Days Before 1st. Germination	High Shelter Amount Sown	High Shelter Living: Oct. 1	High Shelter Growth-Inches: Maximum	High Shelter Growth-Inches: Average	Low Shelter Amount Sown	Low Shelter Living: Oct. 1	Low Shelter Growth-Inches: Maximum	Low Shelter Growth-Inches: Average	REMARKS
Pinus monticola	Lolo N.F., 1911	24,000	85	6-5	19	16 oz	150	1.0	1.5	16 oz	720	2	1	
Pinus monticola	Kaniksu N.F., 1911	21,500	91	6-5	19	16 "	300	1.5	.75	16 "	840	2.5	1.25	36 hours at 140 degrees
Pinus ponderosa	Boise N.F., 1911	6,784	94	6-5	13	4""	400	2.5	1.5	4 "	120	3.0	2.0	Altitude 4000'
Pinus ponderosa	Plumas N.F.	14,144	91	6-21	8	8 "	2,800	2.0	1.5	24 "	2,200	2.0	1.5	
Pinus austriaca	Europe, 1911	25,984	97	6-5	10	12 "	2,200	2.0	1.25	12 "	1,200	2.5	1.5	Damping off
Pinus flexilis	Pike N.F., 1908	5,560	95	7-5		8 "	0			8 "	6	1.0	.75	
Pinus contorta	Wyoming N.F., 1911	54,925	96	6-5	12	4 "	80	1.25	.5	3 "	360	2.0	1.0	
Larix occidentalis	Colville N.F.	94,432	43	6-5	13	12 "	550	2.50	1.0	12 "	3,600	2.5	1.0	
Picea engelmanni	San Isabel N.F., 1911	129,390	97	7-5	11	1½ "	200	.75	.5	2 "	1,600	1.25	1.0	Altitude 9000'
Picea engelmanni	Payette N.F.	169,728	91	6-5	14	1 "	90	.50	.25	2 "	600	.87	.37	Several years old
Picea engelmanni	Whitman N.F., 1911	190,400	74	6-5	13	12 "	1,300	.75	.37	12 "	4,300	2.25	1.5	
Picea parryana	Uncompahgre, 1911	92,450	93	7-5	11	1½ "	2,800	1.0	.75	3/4 "	1,000	1.5	1.0	
Pseudotsuga taxifolia	Corvallis, Ore., 1911	44,928	74	6-5	15	12 "	2,500	3.25	2.5	12 "	3,000	4.5	2.0	
Pseudotsuga taxifolia	Wyoming N.F., 1911	40,560	46	6-5	12	3 "	720	1.75	1.0	4 "	560	2.0	1.0	Altitude 6500' - 7000'
Pseudotsuga taxifolia	Tacoma, Wash., 1911	30,272	94	6-5	19	7 "	800	3.25	2.0	8 "	1,200	4.5	2.5	
Pseudotsuga taxifolia	Trinity N.F.	31,326	89	7-5	--	--	---	----	---	2 "	80	2.0	1.5	Altitude 3800'
Abies concolor	Sierra N.F.	10,240	33	6-21	25	3 "	50	1.5	1.0	4 "	50	1.5	1.25	
Abies magnifica (Shasta)	Crater N.F., 1911	9,856	49	6-5	19	12 "	300	2.75	1.25	12 "	400	4.0	1.0	
Sequoia washingtoniana	Sequoia N.F., 1911	95,269	18	6-21	23	5 "	660	2.0	1.0	5 "	200	1.0	.75	
Chamaecyparis lawsoniana	Siskiyou N.F., 1911	142,688	78	6-5	19	1 "	900	2.75	1.5	2 "	3,300	3.0	2.0	
Libocedrus decurrens	Trinity N.F., 1911	10,112	41	6-21	25	3 "	200	.75	.5	3 "	70	3.37	2.0	

WORK PLANNED FOR 1913

From the killing back of the honey locust and black locust and the injury to some of the terminals of white ash and black walnut, it is considered doubtful whether any of eastern hardwoods except those native to the Lake States and to New England are adapted to the Northern Idaho and Western Montana climate. Further work will, therefore, be concentrated on whatever of these species have not already been introduced, with possibly a few additional species from farther south. As many as can be obtained of the promising species from the coast of Washington and Oregon will also be tried. It is thought that better success is obtained with less expense by obtaining the seed and raising our own plants and this course will be followed in most of the future work.

A few species may possibly be obtained from the Office of Plant Introduction if any look promising for this region. These will probably be of most value as specimens in the arboretum which we hope to build up in connection with this project. The ground in the vicinity of the Experiment Station, about six acres of which we expect to clear of the present coniferous stand for fire protective purposes, offers an excellent site for an arboretum, being slightly rolling with good soil and a heavy moisture-retaining subsoil and having both dry and wet places,--in fact an ideal location for growing trees of all kinds.

The road from the buildings to the stage road, about a quarter mile long, is being widened to sixty feet as a fire line and to improve the roadway. This will give us an opportunity to plant a row of shade trees of some desirable species on each

side of the road within the next two or three years. This and the arboretum will make the grounds of the Experiment Station very attractive to visitors and a show place for the District with a very small actual outlay.

Future work in the introduction of species not native will be incidental to other work as suggested by Mr. Clapp in his Memorandum and can be done with a very small expense of time and money.

COSTS

Past costs for this project include the expenses of clearing a number of plots as well as the purchase of material, cost of transportation and cost of installation. In the future the cost of material and transportation will be small because of the use of seed instead of nursery stock. Since only a few species remain to be introduced and ground has already been partially cleared for these, the cost of clearing and installation will also be small.

Cost up to December 31, 1912 - - - - - - - -$182.48

Estimated cost for 1913 - - - - - - - - - - 75.00

Estimated cost to completion - - - - - - - - ?

PROJECT - PRIEST RIVER - F-si-1

HABITAT EXTENSION - District One

Western yellow pine
Western white pine
Lodgepole pine
Douglas fir

OBJECT:

To determine the possibility of extending the range or habitat of the more valuable species so as to displace less valuable trees or occupy open or waste lands on the various Forests of the District.

WORK DONE PRIOR TO DECEMBER 31, 1912:

With yellow pine, the principal problem is altitudinal extension. It was suggested that the reason why the species has not extended itself to higher limits naturally was because the seed produced at the upper limit of growth was relatively infertile and did not possess germinative force enough to produce strong seedlings which would persist. In order to secure data on this point, two bushels of cones were collected at 7200 feet from stunted trees growing at about the upper limit of the species on the Bitterroot, in connection with the large seed collecting operations on that Forest in the fall of 1912. Two bushels were also gathered from well developed trees growing on a good site at 4000 feet.

These two lots of cones were extracted with gentle heat at the Experiment Station and the seed is being tested in the green house in sand, duplicate tests being run to serve as a check. The relative fertility and germinative force of

the two samples will be determined and may furnish valuable information.

WORK PLANNED FOR 1913:

The problem is principally one of artificial extension, however. A number of the Forests have large areas in need of reforestation above the natural local limits of yellow pine and are in doubt as to the advisability of planting the species on such sites because they are not sure that it will develop into timber or even live to maturity. The solution lies, then, in making experimental plantations on such areas and in trying to locate isolated patches or specimens of the species growing on similar situations so as to determine longevity and value of the product at maturity.

The problem in white pine is latitudinal and longitudinal. It is desired to know how far east its range can be profitably extended in Montana and how how far south the species can be grown in the Selway and Nezperce Forests. Although large planting operations in such extension work will probably not be attempted until the areas within the present range of the species have been thoroughly served, it is essential that the experimental work be started as soon as possible because experiments will have to run a number of years before conclusive information can be obtained,-possibly through an entire rotation, in many cases.

The plan of operation during 1913 and subsequent years is, therefore, to take the matter up with the Forests and find out what experiments are needed along this line, draw up plans

at the Station according to a uniform system, and have the Forest force install them at their earliest opportunity and take periodical observations. In addition, data in regard to all such experimental plantations that have already been started will be compiled and arrangements made for examinations which will work in with the new experiment started.

While this work might be carried on by the office of Planting, it is nevertheless chiefly of an investigative nature and it is felt that it can be best carried on under the direction of the Experiment Station. On some of the Forests definite experiments of this kind which will work in with some District project could perhaps be assigned to the force and particularly the Forest Assistant in place of the somewhat indefinite annual silvical reports now called for. In all such cases the initial action should be taken up with the Supervisors through the District Office, after which routine correspondence can be carried on directly between the Experiment Station and the Forests.

It is not practicable for the Experiment Station to carry on local experiments in habitat extension because, with site conditions favorable, it is possible for white pine and yellow pine to grow many place on the Kaniksu regardless of altitude or latitude. Planting sites will be compared in Project F-sms-1.

COSTS

Cost up to December 31, 1912 - - - - - - $6.10
Estimated cost for 1913 - - - - - - - - 50.00
(Largely the cost of correspondence and planning the work for the different Forests)
Estimated cost for completion - - - - ?

PROJECT - PRIEST RIVER - M-c -1.

CUT-OVER AREA STUDIES.

OBJECT

To determine the factors governing natural reproduction on areas cut-over under different conditions as a basis for proper silvicultural handling of timber sales.

This report is a study of the migration and habitat of the forest-tree seedlings to determine what methods of cutting and slash disposal, also what conditions of soil and shade give best results in the natural regeneration of the desirable species and which serve best to eliminate any undesirable species.

METHODS

Strips 8½ feet wide are run 2½ chains apart thereby covering 5% of the total area and crossing it often enough to get representative areas under all conditions of moisture, shade, exposure (as to slope) and soil.

Operated by two-man crew. One man acts as head chainman, runs compass, using F. S. compass and Jacob's staff, and does the mapping. Maps, showing location of streams, timbered areas, seed-plots, burns and unburned slash areas, are made, with 20 foot contours, thus locating slopes, benches and swamp area. Elevations are taken by

using Abney level and mapped, by comparative elevation only tied in with the nearest bench mark, as this is sufficient for the purposes of this study. The other man takes notes on the kind of soil, whether silt, sandy gravel, clay, etc., ground cover (giving Generic names of plants as it is not necessary to determine species), also condition of soil, whether mineral or covered with humus, duff or litter and amount of charred logs and slash on the ground. Number and age of each species of seedlings are recorded with conditions under which each individual or group of seedlings is found as to soil conditions and shade or protection by logs or slash.

The head chainman advances a chain length and then takes the compass sights and does the mapping, while the rear chainman follows examining the 8½ foot strip with the chain in the center of the strip as a guide. When the head chainman finishes mapping and taking compass sights, or when it is not necessary to do any of this as is often the case, if the rear chainman has not finished the examination of the strip the head chainman begins examination of the strip coming back to meet the rear chainman. Each chain is taken as a unit and written up separately.

The strips are designated by the letters of the alphabet in alphabetical order as they are run, and in case there are more strips than letters in the alphabet they are continued by doubling the letters, as AA, BB, etc. The

chains are numbered by arabic numerals in each strip with a note at the beginning of the strip as to the direction it was run. Thus A3 would mean the 3rd chain in strip A. This makes a complete record for charting and mapping and locates definitely each chain.

In taking notes abbreviations are used to save time so a very complete set of notes can be kept with scarcely any delay. Following is a sample record of one chain:

H 18 Level out of seed plot.
SS H D C L
Ru E La S Arc
11H 1 yr. on D in open
17 W P 1 yr. on M in open
2 W P 2 yr. on M in open
1 L 1 yr. on M in open
146 C 1 yr. on M in open
131 C 1 yr. on M in Sh

Showing that the record is on strip H, 18 chains from starting point and just adjacent to seed-plot. Having a (SS) silt soil covered with (H) humus, (D) duff, and charred logs (C L) with a scattered vegetation cover of (Ru) Rubus, (E) Epilobium, (La) Lathyrus, (S) Salix, and (Arc) Arctostaphylos. In cases where the vegetation cover is heavy notes are taken to that effect. This chain has 11 (H) Hemlock seedlings 1 year old growing on duff, in the open; 17 (W P) White Pine seedlings 1 year old growing on mineral soil in the open; 2 White Pine seedlings 2 years old growing on mineral soil in the open;

1 (L) Larch seedling 1 year old growing on mineral soil in the open; 146 (C) Cedar seedlings 1 year old growing on mineral soil in the open; 131 Cedar seedlings 1 year old growing on mineral soil in the shade.

As the strips are complete transects in themselves, larger plots are located only where special conditions justify the extra time to map the plots.

With this method two men can average about 120 chains per day covering 1.5 acres by actual count and making a total area of 30 acres per day of which 5% is examined. This area would vary depending on the density of reproduction, being slower where the reproduction is dense and much more rapid where reproduction is sparse. Charts are made of all special plots and in permanent plots the seedlings are also staked.

The chart and permanent plots are designated by serial numbers of 100 on each area so they can be readily located as to the area on which they were mapped. On all charted plots and maps the titles are so arranged that when the printing is right side up the top of the chart or map is north.

In the migration charts the number of seedlings per acre given is the number found by the examination of the strips, 5% of the total area, reduced to the number per acre on the total area or 100%. Hence the first chain

distance from the timber shows the total number of seedlings found on the first chain from the timber on all strips run reduced to the number per acre on the total area covered along the edge of the timber to a distance of one chain out. For example - 10 strips running to edge of timber, each 8½ feet wide, would make a total area for each chain length of 1¼ sq. chs. or 1/8 A. actually counted. If the total number of seedlings found on this area was 250 then the number per acre would be 8 x 250 or 2,000. Hence the average number of seedlings per acre for this chain distance from the timber would be 2,000.

The strips are run across the contours where possible as this gives the best average conditions of the slopes.

The methods so far described will apply best to clear-cut areas and would be modified to suit conditions in areas where older stands of seedlings were to be studied and also where the selection system was used or the White Pine and Cedar cut and the Larch, Hemlock and Fir left, or where the White Pine alone had been taken out. Under such conditions plots would be laid out mechanically to insure average conditions and all trees mapped that would influence conditions within the plot. Height, diameter and condition of standing trees would be taken. The plots would necessarily be larger in such localities as the small plot would not be free from surroundingiinfluences. In selection systems or where some species have been left these plots could also be used as increment and deterioration plots

of the species by taking measurements of height and diameter and determining the age of the different age classes. In case these studies were to be made, larger plots including the reproduction plots could be established.

WORK DONE UP TO DECEMBER 31, 1912.

Examinations were made in September by a crew consisting of Forest Assistant J. V. Hofmann, who made counts and examined seedlings, and Forest Assistant H. J. A. Grossmann, who was compass and tally man and did the mapping and ground cover description. Five different areas were examined on the Kaniksu Forest, one on the main Priest River and four on the West Branch of Priest River, all of them in the White Pine type characteristic of bench land near the streams. Results of these examinations are given in detail in the following pages.

WORK PLANNED FOR SEASON OF 1913.

Owing to the importance and immediate value of the information to be secured in this study the field work of the Station in 1913 will be arranged to give this project special emphasis. It is planned to start a crew of two men out as early in the spring as work can be done to advantage. Any other areas on the Kaniksu which are suitable will be covered first and then work will be extended to the Pend Oreille, Coeur d'Alene and St. Joe Forests during the balance of the summer. The methods described will

be varied in the judgment of the Chief-of-Party, to suit the conditions and method of cutting.

COSTS.

Cost to date (3 weeks' work),	$ 241.66
Estimated cost - 1913 (4 months' work)	1,200.00
Estimated cost to completion,	?

DEFINITIONS OF TERMS USED

Mineral soil -- Any exposed soil whether clay, silt, sandy, etc.

Humus --------- Well decayed vegetable matter at surface or mixed with surface soil.

Duff ---------- Partially decayed vegetable matter.

Litter -------- Undecayed needles or leaves and rotted logs that have not entirely disintegrated.

Shade --------- Any seedlings shaded from 20% to 50% -- Estimated.

Open ---------- Seedlings growing in less than 20% shade. Estimated. Usually no protection at all.

Heavy ground cover - Where shading is heavier than 50%. Usually the heavy cover was due to grasses and ferns and in localities where no reproduction occurred.

Adjacent ------ Within one chain distance.

Seed Plot------An area consisting of from 1 to 3 acres of the original stand left uncut to produce seed for the surrounding area. Originally intended to be 25% B.M. of the entire stand. In practice the % of the stand left varies largely from this, sometimes falling below 10%.

INDIVIDUAL AREAS.

Jurgens Brothers, 2/15/10.

Designation Kaniksu - Jurgens Bros., February 15, 1910.

Location N.W.¼, Sec. 34, T 58 N., R. 4 W., Boise M.

Topography Bench land traversed by small creek with adjoining swamp as shown by map. See Chart I.

Soil Deep silt soil well drained, except along swamp.

Condition before cutting Species evenly distributed. White pine most important silviculturally and commercially. Considerable white pine bug killed. All species affected by fungus.

Reproduction- In understory. ¼ A. plots showed 5' and over and less than 6" diameter; hemlock 64, white fir 4, cedar 8; less than 5', same plots, hemlock 30, white fir 4, cedar 4.

Utilization All merchantable timber, living and dead, standing and down, cut.

Brush Disposal Strips 75' to 100' wide cleared and piled along edge of cutting and around seed plots. All hemlock and remaining timber slashed and broadcast burned.

Burned-over May to August, 1911.

Seed Years Good seed year in 1909 and a fair crop in 1911.

Silvicultural System Clear cut with seed plots.

CONDITIONS OF STAND BEFORE CUTTING.

Data	White Pine	Western Larch	W. Red Cedar	Western Hemlock	White Fir	Dead & Down
Approximate diameter limits	0	0	0	0	0	0
Average total height of trees	160'	170'	125'			
Average Diameter of trees	21"	22"	18"			
Average stand feet B.M. per acre	5178	6781	2484			937
Total stand feet B.M.	990 M.	1087 M.	397 M.			150 M.
Merchantable dead timber cords	225	200	720	1000		785
Seedlings less than 5' high, per A.	2560	330	400	2064	18	

Estimated by G. L. Cott--Lumberman.

CUTOVER AREA STUDIES.

PRIEST RIVER EXPERIMENT STATION.

T. 58 N., R. 4 W., BOISE M., SEC. 34, N.W.Q.

Datum 2340

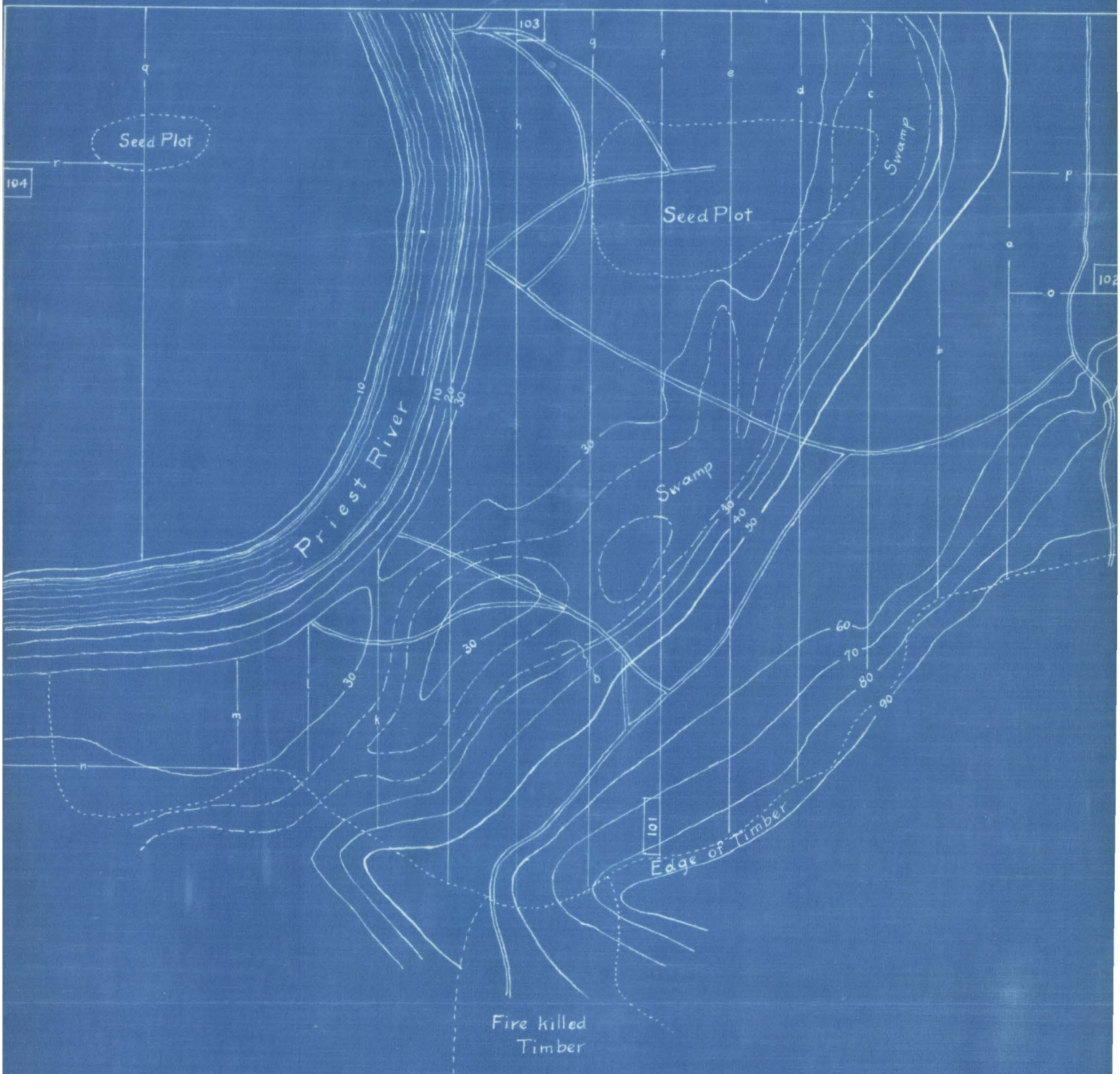
Scale 16 inches = 1 mile.

Kaniksu National Forest.

CHART 1

Mapped by H. Grossmann

Date. Sept. 9, 1912.



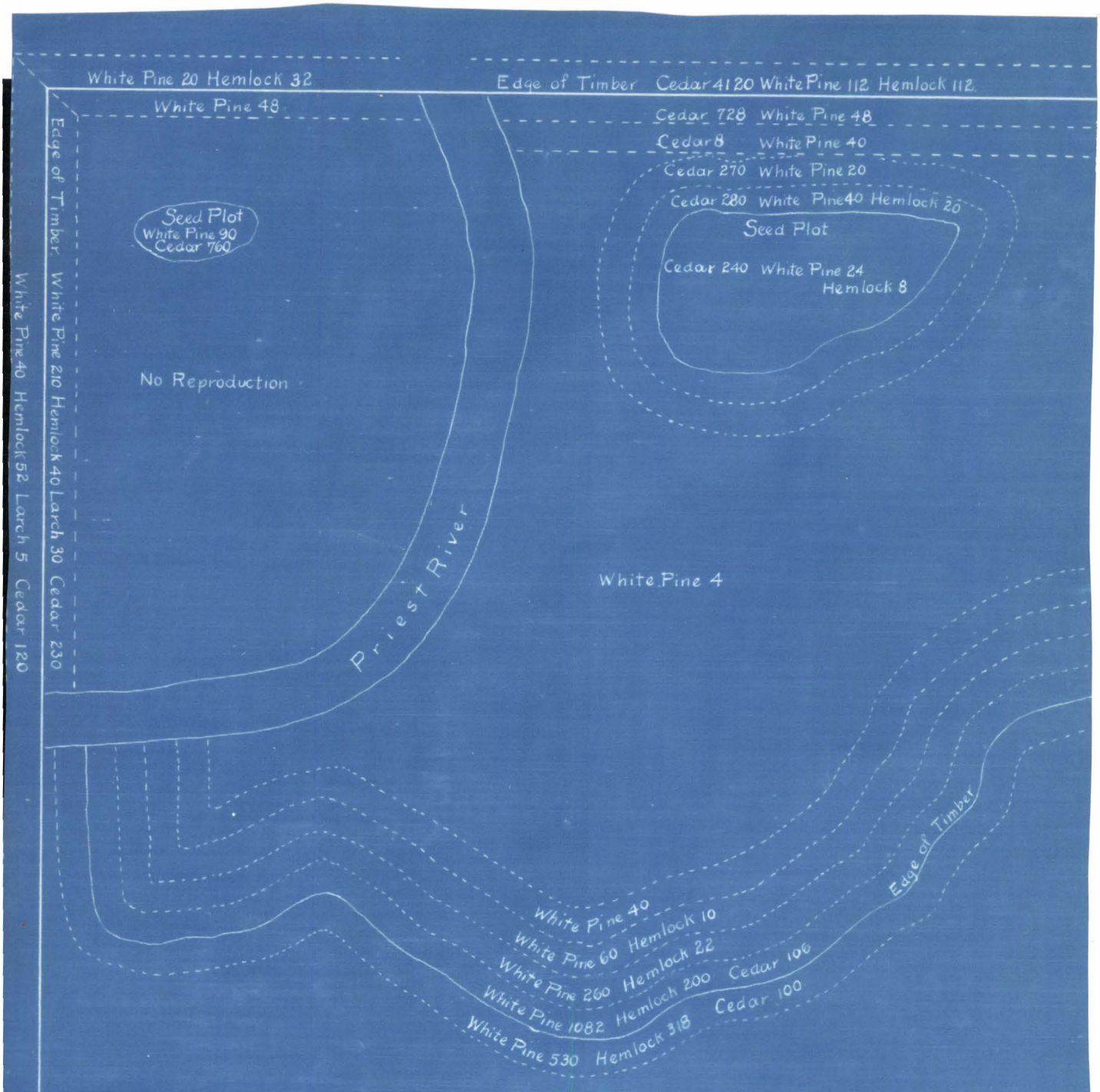

White Pine 20 Hemlock 32
White Pine 48
Edge of Timber White Pine 210 Hemlock 40 Larch 30 Cedar 230
White Pine 40 Hemlock 52 Larch 5 Cedar 120
Seed Plot
White Pine 90
Cedar 760
No Reproduction
Priest River
Edge of Timber Cedar 4120 White Pine 112 Hemlock 112
Cedar 728 White Pine 48
Cedar 8 White Pine 40
Cedar 270 White Pine 20
Cedar 280 White Pine 40 Hemlock 20
Seed Plot
Cedar 240 White Pine 24
Hemlock 8
White Pine 4
White Pine 40
White Pine 60 Hemlock 10
White Pine 260 Hemlock 22
White Pine 1082 Hemlock 200 Cedar 106
White Pine 530 Hemlock 318 Cedar 100
Edge of Timber

CHART 2

MIGRATION CHART

Graphic Representation of Number of Seedlings per Acre

in each Chain Distance from Seed Trees

Kaniksu National Forest

T 58 N., R. 4 W., BOISE M., SEC. 34, N.W.Q Scale 16 in. = 1 Mile

GROUND COVER WHEN EXAMINED SEPTEMBER, 1912.

Scattering individuals of Fire Weed (Epilobium), Thimble Berry (Rubus), False Solomon Seal (Smilacina), Wild Rose (Rosa), Elder (Sambucus), Vetchling (Lathyrus) Nettle (Stachys), Thistle (Carduus), Lamb's Quarter (Chenopodium), Dandelion (Taraxacum), Violet (Viola), Strawberry (Fragaria), Honeysuckle (Lonicera), Solomon Seal (Polygonatum), Bearberry (Arctostaphylos), (Pachistima), Willow (Salix), Mountain Maple (Acer), Fern (Pteris), Alder (Alnus), Mint (Pycnanthemum), Liverwort (Marchantia), (Spiraea), various kinds of grassin tufts and clover (Trifolium) along the skidding roads.

The entire area is now, after one season, sparsely covered with the above named vegetation which indicates that within the next few years a heavy ground cover will form. The area shown on the map in Chart I as swampy is heavily covered with grass and ferns and patches of willow and alder brush so there is no chance for reproduction to start on this area. Most of the area on the west side of Priest River is heavily covered with grass, alder, ferns, and spiraea mixed with other species making a ground cover too heavy for reproduction to get started. But this ground cover has formed since the cut and burn, showing that no reprodnction came in after the burn when the mineral soil was exposed and the seedlings would have had the same chance to start as the annuals. The roots of the perennials were not killed by the fire hence

caused the heavy vegetative cover the first season.

The entire area is covered with scattered charred logs of hemlock and parts left from other species, as shown in Plots I, II, and III. The mineral soil is exposed on most of the area with patches of humus and duff and some litter along the edge of the timber or in the seed plots.

The migration chart, Chart II, shows that the reproduction extends about two chains from the timber in all directions, regardless of the prevailing wind direction during the seeding season. On the slopes on the south side of the area the burn was not as severe, patches being left unburned and on others the humus and duff was not burned. The heavier reproduction shown in this locality by the migration chart consists of one, two, and three year old seedlings showing that the seed and seedlings on the ground were not killed by the fires of 1911.

All chart and permanent plots on this area are designated by the serial number 100.

PERMANENT PLOTS.

Permanent Plot No. 101.

Size and Location — ½ chain wide, along the timber, by 2 chains long, out from the timber, at south end of Jurgen's Bros. cutting, on Sec. 34 at end of strip P.

Aspect — 18% slope, north and east.

Soil — Silt, well drained.

Ground Cover — Duff and litter along timber and patches of humus and mineral soil further out where the fire was most severe. Charred logs scattered over the area. Scattering individuals of Bearberry, Fireweed, Thimbleberry, Elder, and Thistle, not dense enough to cause any appreciable shading.

Direction from seed trees - North.

Seed trees within one chain of plot - 4 white pines 12 to 20 inches D.B.H., 5 cedars 16 to 25 inches D.B.H., 1 hemlock 11 inches D.B.H., 1 larch 25 inches D.B.H., all in good condition for producing seed.

Most of the cedar reproduction is under logs where the mineral soil is exposed and is usually in patches covered with Marchantia, showing that there is plenty of moisture.

Chart III shows the distribution of the seedlings on this plot. All stakes are set on the east side of the seedlings which they mark.

CUT OVER AREA STUDIES.

PRIEST RIVER EXPERIMENT STATION

PLOT NO. 101.

Mapped by H. Grossmann CHART 3 Date. Sept 18, 1912. S

Legend

o White Pine
C Cedar
L Larch
H Hemlock
Number indicates age of Seedling

Permanent Plot No. 102.

Size and location 1 chain square. At east side of Jurgens Bros. cutting on Sec. 24, at end of strip O.

Aspect Level on bench land.

Soil Silt, well drained.

Ground cover Humus and duff and strips of wood litter. Charred logs scattered over plot. Individuals of rose, thimbleberry, grass, vetchling, fireweed, not forming a heavy cover at any place.

Direction from seed trees - West.

Seed trees within one chain of plot - 3 white pines 20 to 24 inches D.B.H., 3 cedars 20 to 30 inches D.B.H., 5 hemlocks 18 to 20 inches D.B.H., 1 larch 24 inches D.B.H. All in good condition for seeding.

All cedar seedlings found where the mineral soil was exposed and covered with Marchantia, being in moist places.

Chart IV shows the distribution of the seedlings on this plot.

PLOT NO. 102

Scale 8 in. = 1 chain CHART 4 Date. Sept. 18, 1912.

Permanent Plot No. 103.

Size and location 1 chain square. At north side of Jurgens Bros. cutting on Sec. 34, at end of strip H.

Aspect Level bottom land.

Soil Silt, moist.

Ground cover Mineral soil exposed with patches of humus and duff. Some charred logs on plot. Scattering individuals of elder, thimbleberry, bearberry, vetchling, and grass.

Direction from seed trees - South

Seed trees within one chain of plot - 2 white pines 16 and 18 inches D.B.H., 6 cedars 18 to 30 inches D.B.H., 1 larch 16 inches D.B.H., all in good condition for seeding.

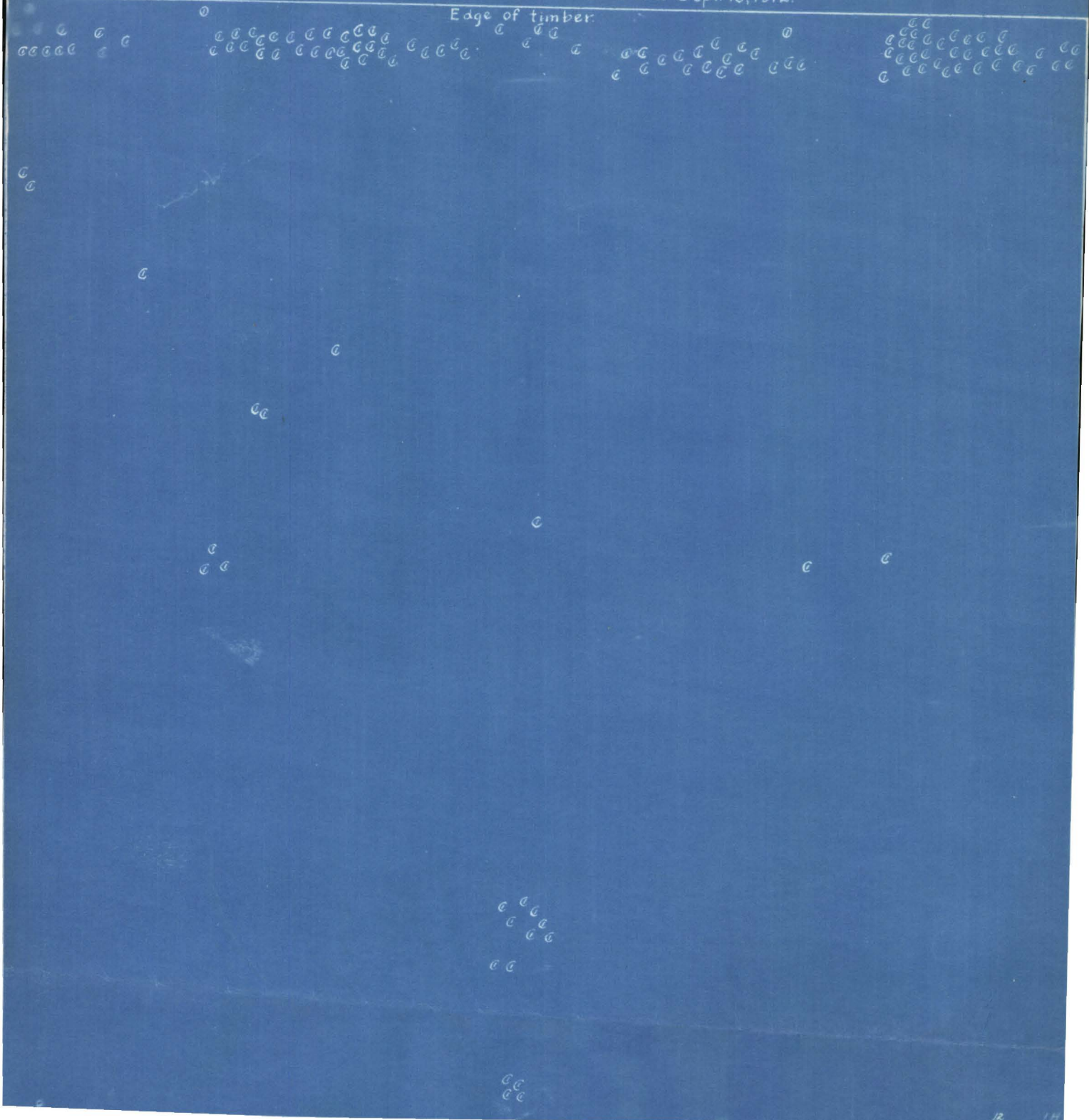
All cedar seedlings found in moist places where mineral soil was covered with Marchantia and moss.

Chart V shows the distribution of the seedlings on this plot.

PLOT NO. 103.

Scale 8 in. = 1 chain CHART 5 Date. Sept. 18, 1912.

Edge of timber.



Permanent Plot No. 104.

Size and location: 1 chain square. At west side of Jurgens Bros. cutting on Sec. 34, 6 chains south from the N.W. corner of Sec. 34.

Aspect: Level bottom land.

Soil: Silt, usually moist or wet.

Ground cover: Patches of humus, litter and duff, covered by light fire. Several charred logs on plot. Scattered individuals of willow, thimbleberry, fireweed, ferns, grass and Solomon Seal.

Direction from seed trees - South.

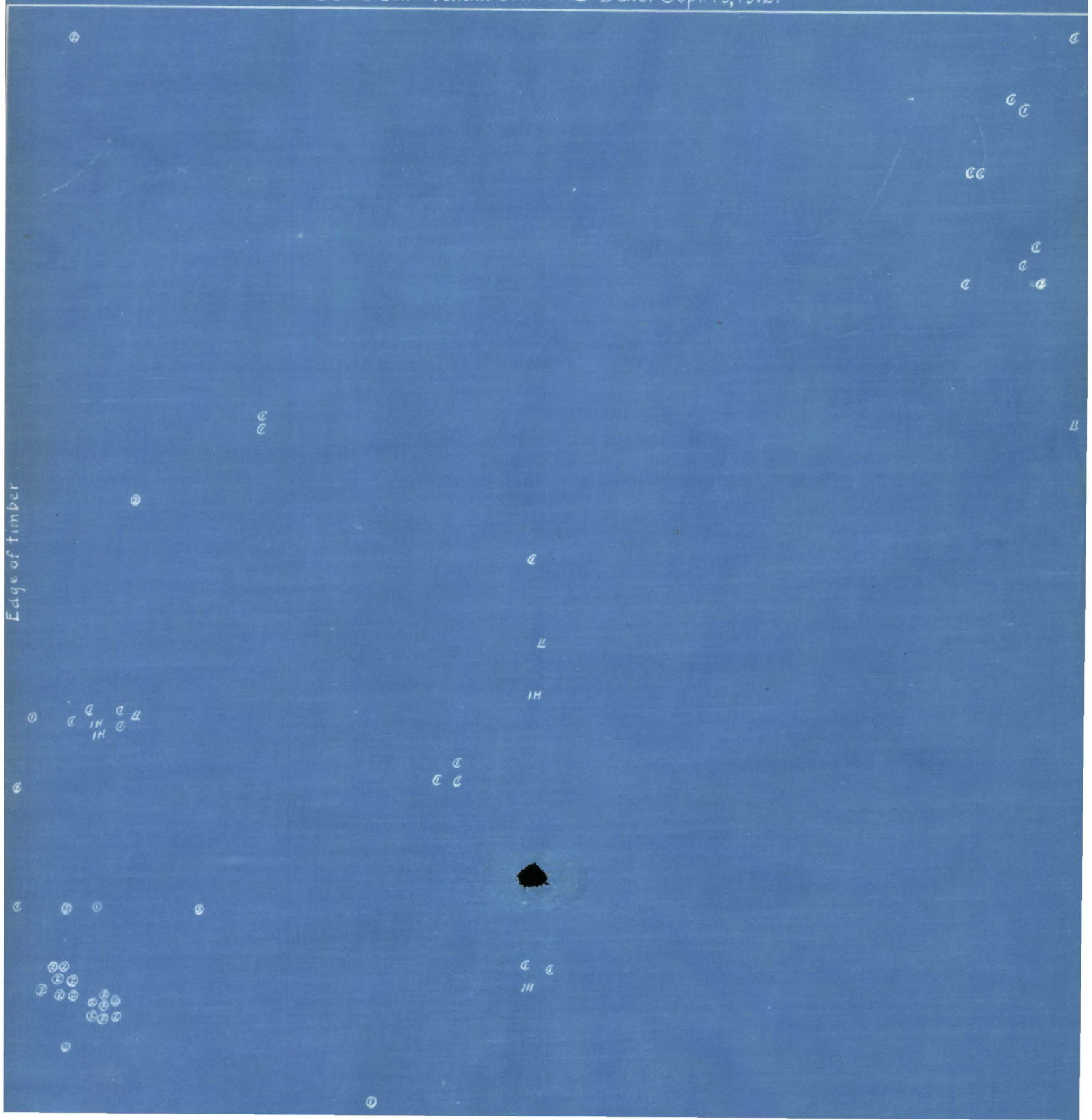
Seed trees within one chain of plot - 10 white pines 12 to 24 inches D.B.H., 5 cedars 8 to 12 inches D.B.H., 2 larches 16 and 20 inches D.B.H., all in good condition for seeding.

Cedar seedlings found in moist places where mineral soil was exposed.

Chart VI shows the distribution of the seedlings on this plot.

PLOT NO. 104

Scale 8 in. = 1 chain. CHART 6 Date. Sept. 19, 1912.



CONDITIONS UNDER WHICH SEEDLINGS WERE FOUND.

	White Pine	Cedar	Hemlock
SOIL			
On Humus	6%	1%	26%
" Duff	65%	42%	51%
" Wood Litter	15%	20%	13%
" Mineral Soil	14%	37%	10%
PROTECTION			
In Shade	25%	59%	50%
Under Logs	9%	1%	8%
In Open	66%	40%	42%
AGE			
1 yr. old	60%	97%	85%
2 yrs. "	30%	3%	15%
3 " "	10%		

PLATE NO. 40.

PROJECT - PRIEST RIVER - M-c-1.

Central view of Jurgens cut Sec. 34, looking north showing condition of ground cover. In background at the right is the bench where experimental plots of exotics are planted. Toward the center in the background the steep slope dropping to the next bench, some 300 feet below, is shown.

PLATE NO. 41.

PROJECT - PRIEST RIVER - M-c-1.

Jurgens cut Sec. 34, looking south showing rolling character of land. X marks location of permanent plot 101. The thrifty condition of the seed trees is shown in the background.

PLATE NO. 42.

PROJECT - PRIEST RIVER - M-c-1.

Showing part of Jurgens cut, Sec. 34, west of Priest River. X shows location of permanent plot 104 with the excellent stand of seed trees in the background.

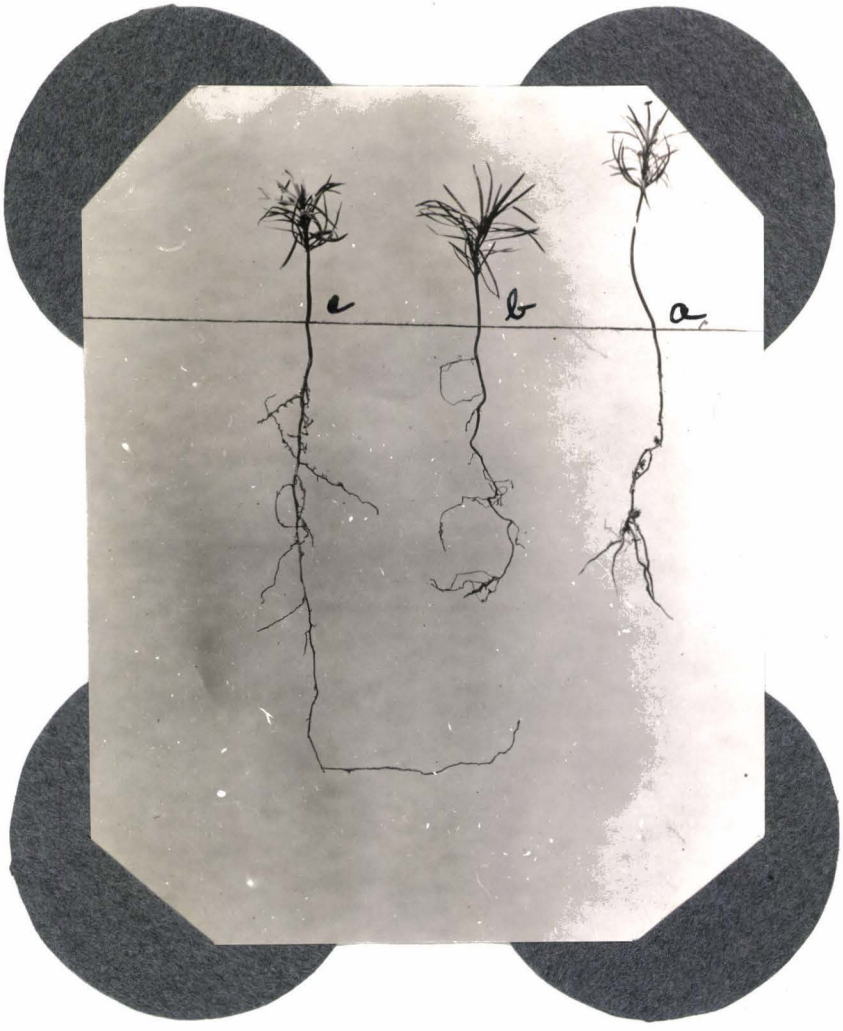


PLATE NO. 43.

PROJECT - PRIEST RIVER - M-c-1.

Top and root development of white pine seedlings grown under different conditions. (a) 2 yr. old grown on duff, single root pushing its way through the duff until it reached the mineral soil where it developed laterals. (b) 2 yr. old grown on wood litter, showing the way the growing root tip follows the crevices back and forth between the annual rings and develops laterals to follow the moisture. (c) 2 yr. old grown on mineral soil, showing the long tap root developed to seek the deeper moisture. All seedlings were grown without protection or shade and the difference in top development is apparently due to the varying amounts of moisture available at the different periods of growth. The seedling grown in the mnieral soil formed a shorter, sturdier top and established a deeper more permanent root system, while the others, with more available moisture near the surface, developed larger tops and smaller root systems. It is apparent that the seedlings grown on the mineral soil are best prepared for any unfavorable conditions. (d) shows the ground line of all three. Many seedlings found under these conditions were dug and these taken as typical examples. Top and root measurements varied from 2.2 inch top and 3 inch root for "a" to 1.4 inch top and 6.8 inch root for "c".

PLATE NO. 44.

PROJECT * PRIEST RIVER - M-c-1.

Jurgens Bros. cutting, Sec. 34. The large seed plot in south part of area on a small ridge, showing character of 250 year old stand of White Pine, Larch, Hemlock, and Cedar. Large tree in center is White Pine 42" D.B.H. and 180' high.

FIDELITY CUTTING - SEC. 26.

Designation Kaniksu - Fidelity Lumber Co., March 18, 1907.

Location Sec. 26, T. 57 N., R. 5 W., Boise M.

Topography Rolling, traversed by Pine Creek, a non-drivable stream, and the West Branch River, a drivable stream. Slopes and ravines shown by map.

Soil Silt and sandy loam, dry, gravelly on hillsides.

Condition before cutting Forest mature and over-mature consisting of two age classes of 100 years and 200 years. Considerable fungus and bug injury.

Reproduction Hemlock and cedar heavy throughout. White pine and larch in groups in openings.

Utilization All merchantable timber, living and dead, standing and down, cut.

Brush Disposal All unmerchantable timber slashed and broadcast burned.

Burned-over June, 1910.

Seed Years Good seed crop in 1909 and a fair crop in 1911.

Silvicultural System Clear cut with seed plots.

CONDITION OF STAND BEFORE CUTTING.

Data	White Pine	Western Larch	Douglas Fir	W. Red Cedar	Cedar Poles
Average total height of trees	140'	140'	120'	120'	75'
Average diam. of trees	20.1"	20.4"	20.4"	27.0"	12.8"
Average number of trees per A.	27.4	3.7	0.8	2.8	17.0
Average stand feet B.M. per A.	17,546	2,068	358	2,496	545
Percent of total stand	79	11	2.5	7.5	
Seedlings less than 5' high per acre % of stand	30	10	10	50	
Trees between 5' high and 6" D.B.H. per acre	10	2.5	2	16	
Number trees above 6" D.B.H. to be left	4.5	1.5	0.5	5.2	

Considerable hemlock was scattered all through the stand, especially young growth of the pole, sapling and seedling staggs, which was not taken into consideration in the above estimate.

CUT OVER AREA STUDIES.

PRIEST RIVER EXPERIMENT STATION

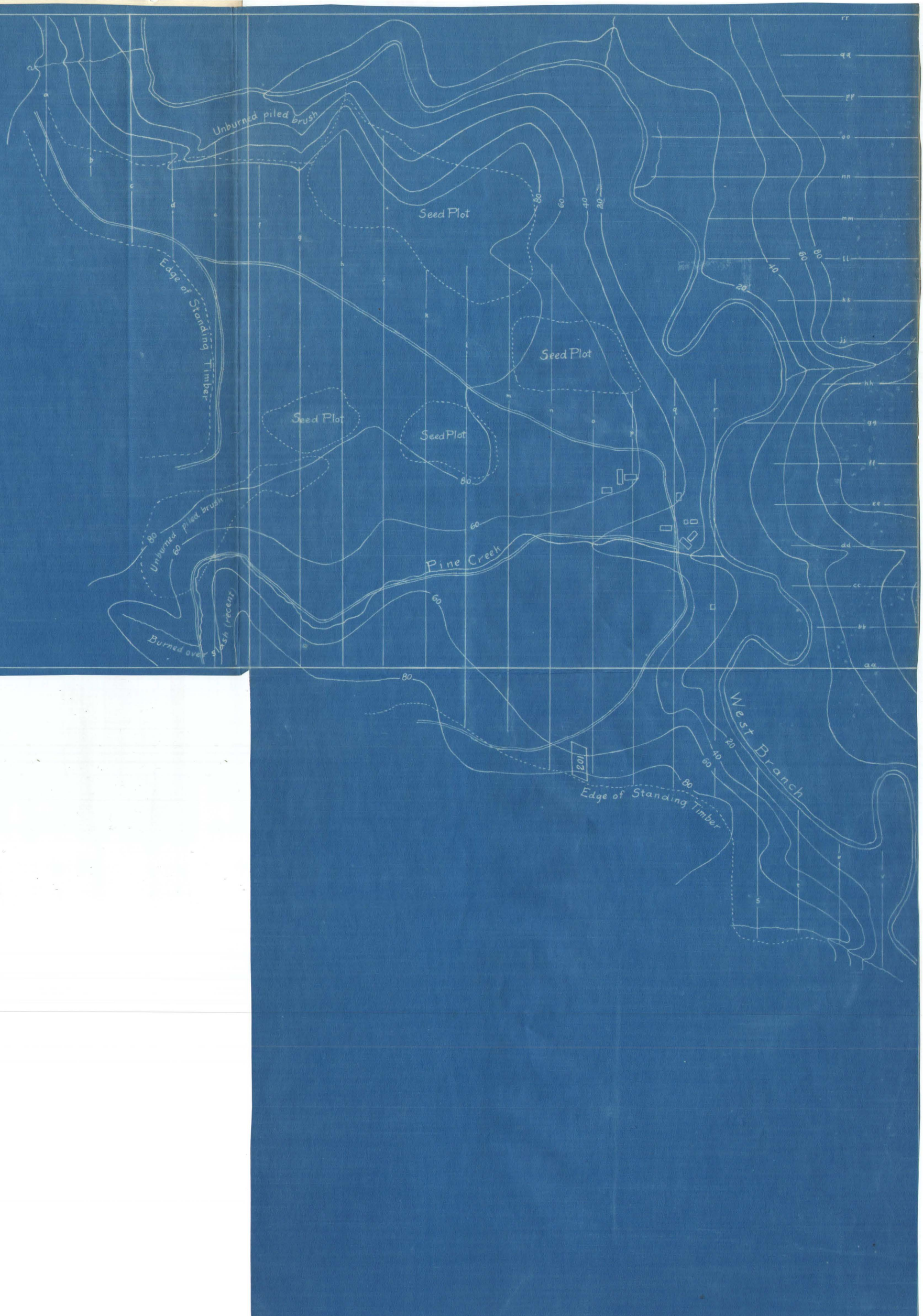
T. 57 N., R 5 W., BOISE M., SEC. 26.

Datum 2295. Scale 16 inches = 1 mile.

Contour interval 20 ft. Kaniksu National Forest.

Mapped by H. Brossmann. Date. Sept. 20, 1912.

CHART 7



MIGRATION CHART

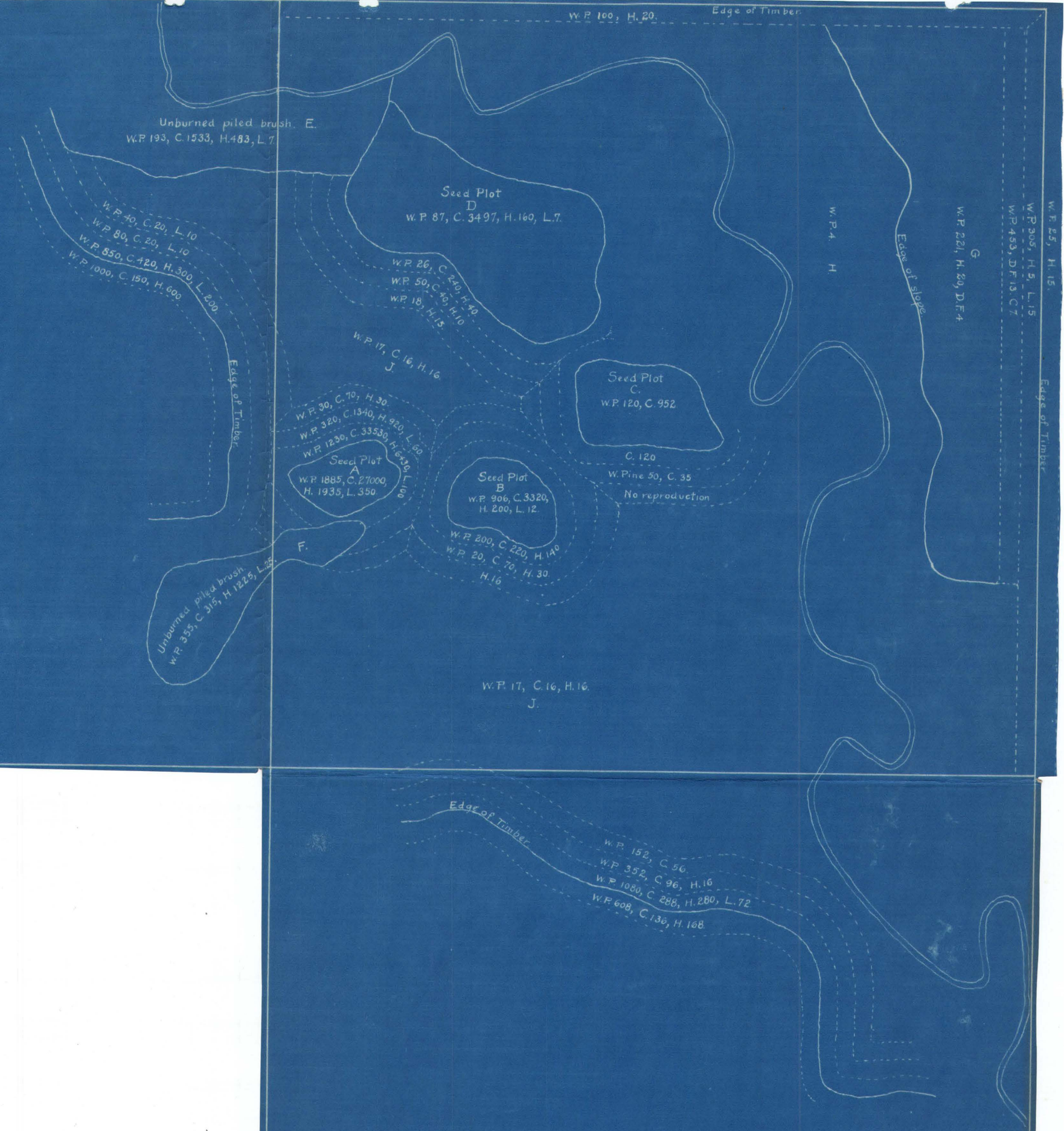
Graphic Representation of Number of Seedlings per Acre in each Chain Distance from Seed Trees

T. 57 N., R. 5 W., BOISE M., SEC. 26. Scale 16 in. = 1 Mile.

Kani Ksu National Forest.

W.P. = White Pine
C. = Cedar.
H = Hemlock.
L = Larch.
D.F = Douglas Fir.

CHART 8


W.P. 100, H. 20.
Edge of Timber
Unburned piled brush. E.
W.P. 193, C. 1533, H. 483, L. 7.
W.P. 40, C. 20, L. 10
W.P. 80, C. 20, L. 10
W.P. 850, C. 420, H. 300, L. 200
W.P. 1000, C. 150, H. 600
Edge of Timber
Seed Plot D
W.P. 87, C. 3497, H. 160, L. 7.
W.P. 26, C. 240, H. 40
W.P. 50, C. 40, H. 10
W.P. 18, H. 15
W.P. 17, C. 16, H. 16.
J.
W.P. 30, C. 70, H. 30.
W.P. 320, C. 1340, H. 920, L. 60
W.P. 1230, C. 33530, H. 6430, L. 160
Seed Plot A
W.P. 1885, C. 27000, H. 1935, L. 350
Seed Plot B
W.P. 906, C. 3320, H. 200, L. 12.
W.P. 200, C. 220, H. 140
W.P. 20, C. 70, H. 30.
H. 16
Seed Plot C.
W.P. 120, C. 952
C. 120
W. Pine 50, C. 35
No reproduction
F.
Unburned piled brush
W.P. 355, C. 315, H. 1225, L. 25.
W.P. 4 H
Edge of slope
G
W.P. 221, H. 20, D.F. 4
W.P. 25, H. 15.
W.P. 305, H. 5, L. 15
W.P. 453, D.F. 13. C. 7.
Edge of Timber
W.P. 17, C. 16, H. 16.
J.

GROUND COVER WHEN EXAMINED SEPTEMBER 1912.

Scattering individuals of Wild Rose (Rosa), Bearberry (Arctostaphylos), Thimble Berry (Rubus), Solomon Seal (Polygonatum), Fern (Pteris), Fireweed (Epilobium), Mountain Maple (Acer), Willow (Salix), Service Berry (Amelanchier), Vetchling (Lathyrus), Thistle (Carduus), Horsetail (Equisetum), Lupine (Lupinus), Alder (Alnus), Goldenrod (Solidago), Spiraea, Lamb's Quarter (Chenopodium), various kinds of grasses in tufts and in heavy stands on river bottom flats and clover (Trifolium) along the road sides, making a ground cover of about 50% but not an even cover as the vegetation is in groups with many open or sparsely covered areas.

The areas burned are quite free from any material left on the ground except some scattered charred logs. The mineral soil is exposed in many places and the remainder is covered with spots of humus and duff with strips of needle and wood litter along the timber where the fire did not run. The soil has been in excellent condition for reproduction since the burn of June 1910 and is still in good condition, so that the absence of reproduction is not due to soil conditions. Along the West Branch River and Pine Creek the low flat land is heavily covered with grasses and ferns, which leaves these areas in an unfavorable condition for reproduction.

The cutting, as a whole, naturally divides itself into several units which have similar factors influencing reproduction, such as seed plots, slopes, slash, etc. Chart VII shows the topography of the area and the position and direction

of the strips run. Chart VIII, the migration chart, also shows the area divided into units having similar factors influencing reproduction. These areas are designated by the letters of the alphabet and in case any letter appears on two or more areas it indicates that these areas are similar.

Areas A, B, C, and D are all within seed plots under about 50% shade with sparse annuals and ground cover of duff, humus, and litter. The seed trees in the plots are healthy except in C and in the edge of D, where they have been Badly damaged by fire. E is an area of unburned partially piled slash on a steep north slope of 20 to 40% with scattered small trees of hemlock and cedar. The ground cover is of sparse annuals and patches of humus, duff and litter.

Area F is an area of unburned partially piled slash on a southeast slope of 15 to 20%. The ground cover consists of scattered annuals and a large percent of the soil is covered with litter and duff. Scattered trees of hemlock and small cedar were left standing on this area.

G is practically level. The greater part of it is unburned slash, partially piled, and the northern part of it has a pole stand of grand fir and cedar. The ground cover consists of a few annuals and litter and duff with some exposed places of mineral soil.

H is a south and west slope of 10 to 40%, very dry hot situation. The north half of this area is covered with unburned piled slash. Ground cover of scattering annuals and tufts of grass except along the West Branch River where there is a heavy cover as previously described.

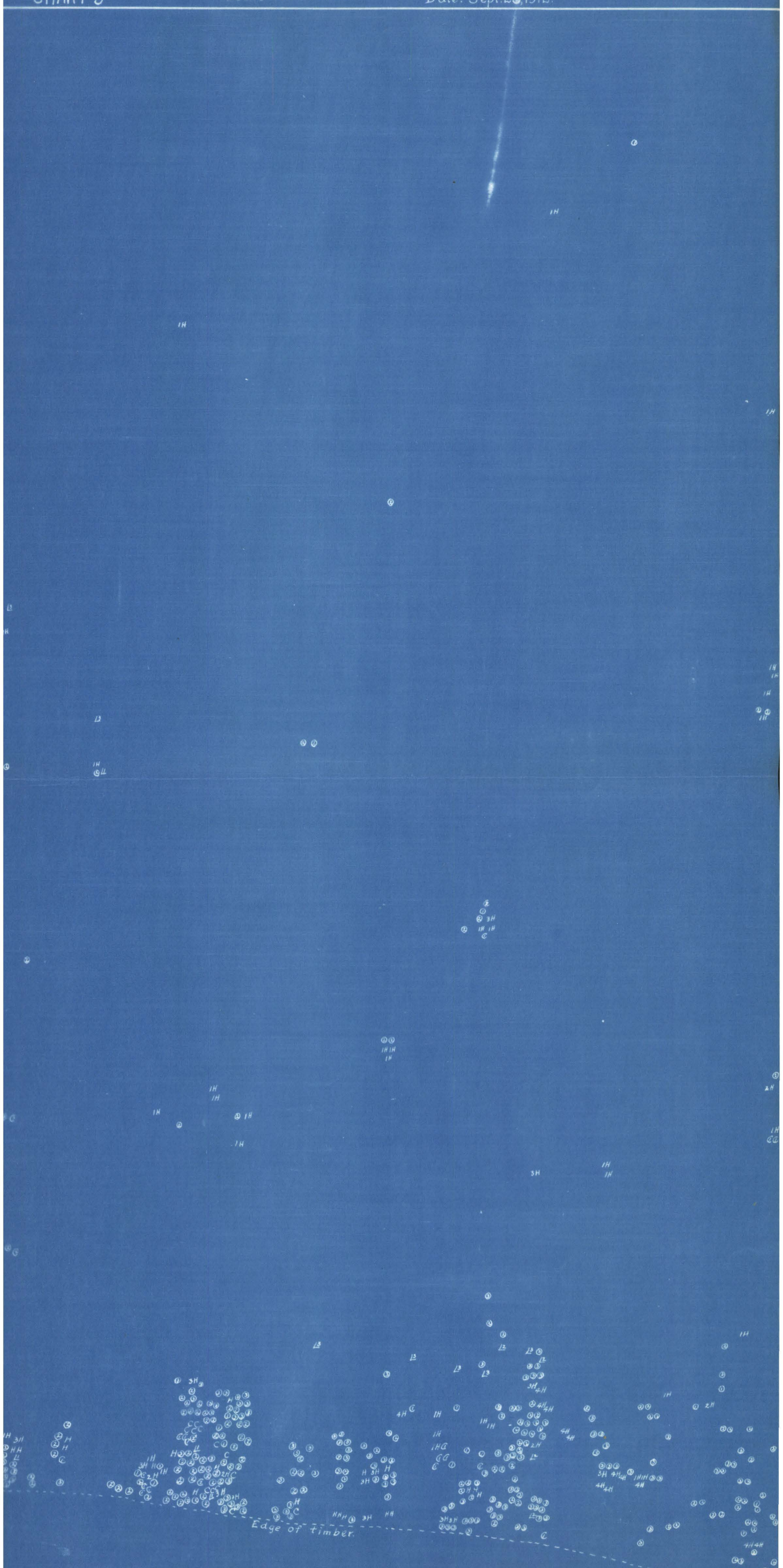
J is the general broadcast burned area consisting of flat benches and slopes. The ground cover is described previously in the general description.

The migration chart shows that the reproduction is much heavier on all of the areas where the slash was left unburned. This is undoubtedly due to the seed and seedlings left on the ground at time of cutting as there are no seed trees in the near vicinity of areas E, F, and G to reseed them and all the burned areas along side of these areas had no reproduction on them. Areas E, F, and G had seed trees of cedar and hemlock on them but no white pine.

All chart plots on this area are designated by the serial number 200.

PLOT NO. 201.

CHART 9 Scale 8 in. = 1 chain Date. Sept. 23, 1912.



Permanent Plot No. 201.

Size and location 1 chain wide along timber by 2 chains long out from timber. At south side of Fidelity cut on Sec. 26. 4 chains east from point where road running to camp enters timber.

Aspect North and east slops of 15%

Soil Silt, well drained.

Ground Cover Duff and litter along timber, patches of humus and mineral soil further out. Several charred logs on plot. Individual plant of Thimbleberry, fireweed, bearberry, and grass making a cover of 25 to 50% shade in places.

Direction from seed trees North.

Seed trees within one chain of plot 4 white pines 14 to 20 inches D.B.H., 2 cedars 16 and 20 inches D.B.H., 1 larch 22 inches D.B.H., 3 hemlocks 14 to 18 inches D.B.H., all in good condition for seeding.

Chart IX shows the distribution of the seedlings on this plot. Nearly all of the reproduction is in a strip along the edge of the timber which was not burned over.

CONDITIONS UNDER WHICH SEEDLINGS WERE FOUND.

	White Pine	Cedar	Hemlock	Larch
SOIL				
On Humus	2%	1%	2%	
" Duff	30%	6%	24%	63%
" Wood Litter	35%	11%	33%	7%
" Mineral Soil	33%	82%	41%	30%
PROTECTION				
In Shade	44%	69%	54%	37%
Under Logs	6%	2%	7%	5%
In Open	50%	29%	39%	58%
AGE				
1 yr. old	43%	87%	81%	48%
2 yrs. "	25%	12%	7%	16%
3 " "	27%	1%	10%	28%
4 " "	5%		2%	6%

PLATE NO. 45.

PROJECT - PRIEST RIVER - M-c-1.

General view of Fidelity cutting Sec. 26 showing ground cover. In left center of view is shown the unburned broadcast slash where a seed plot has been cut after it was killed by fire during the broadcast burning of the area. Although the slash was left unburned, there is no reproduction because the fire killed all the seed and seedlings on the ground before cutting.

PLATE NO. 46.

PROJECT - PRIEST RIVER - M-c-1.

Looking northwest over Fidelity cutting on Sec. 26. Seed Plot B in center of view. Seed Plot A at left, and Seed Plot C at right with Seed Plot D showing in background between B and C.

PLATE NO. 47.

PROJECT - PRIEST RIVER - M-c-1.

A 30 to 40% slope on east side of West Branch River on Fidelity cutting Sec. 26. Slash piled in rows but not burned. Area shown in H chart 8.

PLATE NO. 48.

PROJECT - PRIEST RIVER - M-c-1.

An old uprooted stump at the north edge of seed plot A Fidelity cutting Sec. 26. The tree has decayed but the mound of earth remains. The north side of the mound is covered with Marchantia and moss. On the north side of the mound the moist mineral soil is exposed, making a typical cedar seedling site. In this locality there are 800 cedar seedlings 1 yr. old on an area of 6 sq. ft., while there is no cedar reproduction around the mound on the flat litter or duff.

PLATE NO. 49.

PROJECT - PRIEST RIVER - M-c-1.

An old decayed uprooted stump with conditions similar to the one in Plate 48. Located at the north side of seed plot B. On the north side of this moun there are 230 cedar seedlings 1 yr. old, 1 white pine 1 yr. old, and 2 hemlocks 1 yr. old on an area of 6 square feet.

PLATE NO. 50.

PROJECT - PRIEST RIVER - M-c-1.

Looking southeast from west end of Fidelity cut Sec. 26, showing ground cover and proximity of seed plots. Trees in seed plots 100' to 125' high. Seed plot B to right and A to left. Smoke in background due to burning of slash shown in Plate 47.

PLATE NO. 51.

PROJECT - PRIEST RIVER - M-c-1.

View of seed plot D showing the white pine and cedar seed trees killed by fire running into the plot during the broadcast burning. The larch is the only species left to do any seeding.

PLATE NO. 52.

PROJECT - PRIEST RIVER - M-c-1.

Close view of seed plot A showing the healthy thrifty condition of the seed trees of white pine, cedar and larch. Fire was kept out of this plot.

FIDELITY CUTTING - SEC. 20.

Designation Kaniksu - Fidelity Lumber Co., March 18, 1907.

Location Sec. 20, T. 57 N., R. 5 W., Boise M.

Topography Level with north end rolling as shown by map in Chart 10. North end traversed by two small non-drivable creeks. Slope on south side.

Soil Deep, moist, sandy loam. On hill sides shallow, dry gravelly. No erosion.

Condition before cutting Forest mature and over-mature. Age classes 100, 200, and 300 years. Some parts seriously fire injured 20 years before cutting. Some bug killed.

Reproduction Cedar and hemlock heavy throughout stand. White pine and larch confined to groups.

Utilization All merchantable dead timber standing or down, and all live timber marked by Forest Officers.

Silvicultural system used Clear cutting with scattered seed trees left. Nearly all of the seed trees blown down the first season and the remaining ones were blown down the second season. These trees had very little chance to reseed the area and what cones they did produce were gathered by the squirrels as noted by Ranger McEwan.

CONDITION OF STAND BEFORE CUTTING.

Data	White Pine	Western Larch	Douglas Fir	W. Red Cedar	Cedar Poles
Average total height of trees	145'	160'	140'	125'	80'
Average diam. of trees	24.2"	28.7"	28.4"	28.6"	13.6"
Average stand feet B.M. per acre	11,154	6,004	881	1,091	339 lineal feet
Seedlings less than 5' high per A.	50	15	20	90	Hemlock 80
Trees between 5' high and 6" D.B.H. per A.	14	3	5	30	20
Number trees over 6" D.B.H. to be left	6	1.8	1	3.5	5

Estimated by Forest Assistant R. L. Fromme.

CUT OVER AREA STUDIES.

PRIEST RIVER EXPERIMENT STATION.

T. 57 N., R. 5 W., BOISE M., SEC. 20, NE. & SE. Q.

Datum 2295 Scale 16 inches = 1 mile.

Contour interval 20 ft. Kaniksu National Forest.

Mapped by H. Grossmann Date. Sept. 25, 1912.

CHART 10

White Pine 100, Cedar 380, Hemlock 260, D. Fir 10 — Edge of Timber

White Pine 380, Cedar 240, Hemlock 2520, D. Fir 20 — Larch 60

White Pine 300, Hemlock 1780, D. Fir 100, Larch 60

White Pine 520, Cedar 60, Hemlock 80, Larch 100

White Pine 320, Larch 100

Cornplanter Area
White Pine 260
Larch 20

Edge of Timber
White Pine 1720, Cedar 3800, Larch 360

Broadcast Area
White Pine 140, Cedar 4, Hemlock 5, Larch 10

Brush Land

Edge of Timber

White Pine 15, Larch 4, Cedar 1.

White Pine 30

White Pine 40, Cedar 146, Larch 40.

White Pine 573, Cedar 600, Larch 146, D. Fir 26

White Pine 533, Cedar 280, Larch 93

T. 57 N., R. 5 W., BOISE M., SEC. 20. N.E. & S.E.Q.

MIGRATION CHART

Graphic Representation of Number of Seedlings per Acre
in each Chain Distance from Seed Trees

Kaniksu National Forest. CHART II Scale 16 in. = 1 Mile.

GROUND COVER WHEN EXAMINED SEPTEMBER 1913.

A uniform scattering cover consisting of Thistle (Carduus), mixed with individuals of Elder (Sambucus), Fireweed (Epilobium), Thimbleberry (Rubus), Fern (Pteris), Bearberry (Arctostaphylos), Mountain Maple (Acer), Willow (Salix), Lupine (Lupinus), Vetchling (Lathyrus), Alder (Alnus), Horsetail (Equisetum), Spiraea, Serviceberry (Amelanchier), Wild Rose (Rosa), and tufts of grass.

Along the creeks and in flat places the grass and ferns form a heavy cover.

The entire area was covered by a clean broadcast burn in May 1909, leaving only a few charred logs scattered over the area. A small part in the northwest corner was left unburned and the migration chart, Chart No. 11, shows the comparatively larger amount of reproduction in this area due, apparently, to the seed and seedlings left on the ground at time of logging.

The mineral soil is exposed on a large percent of the area and patches are covered with humus and duff. The soil has been in excellent condition for reproduction since the burn and now is in good condition except that the thistles and weeds will soon form a heavy cover and prevent reproduction from starting.

A part of this area was used for experimental sowing by the broadcast and cornplanted methods in the fall of 1909. The area was shown to western white pine only. A total of 50

acres was sown broadcast and three acres planted with the cornplanter in October, 1909. The seed sown by cornplanter was spaced 3 feet by 6 feet, and 2½ pounds of seed were used per acre. In the broadcast sowing 4 pounds of seed were used per acre.

COSTS

All costs chargeable to project:

Seed	$522.72
Surveying	1.67
Sowing	8.06
Marking	1.04
Field Expenses	24.70
Travel	5.25
	$563.44

Cost per acre, $10.67

Costs computed on basis of work done

Seed, 198 lbs. at $2.64	$522.72
Surveying	1.67
Sowing	8.06
Marking	1.04
	$533.42

Cost per acre, $10.10

RESULTS

The area was examined on July 20, 1910, at which time an average of 125 seedlings per acre were found on the area sown by the broadcast method. The seedlings were found mostly on roads and places where the soil was bare. On the planted area seedlings had come up on about one-half of the acreage planted.

On October 20, 1910, another examination was made by Assistant Ranger S. S. McEwan and Deputy Supervisor E. B. Brown. Both report that practically no seedlings could be found on the area, although it had not been burned over by the summer fires. They attribute the dying out of the seedlings noted earlier in the summer to the exceedingly dry weather of the past summer.

Migration chart No. 11 shows these areas and the number of seedlings per acre found by the examination in the fall of 1912. This chart shows the number of seedlings per acre on the cornplanter sown area, the broadcast sown area, and also the area that was left unsown.

CONDITIONS UNDER WHICH SEEDLINGS WERE FOUND.

	White Pine	W. Red Cedar	Western Hemlock	Western Larch
SOIL				
On Humus	3%			1%
" Duff	23%	8%	1%	20%
" Wood Litter	29%	48%	98%	29%
" Mineral Soil	45%	45%	1%	50%
PROTECTION				
In Shade	15%	68%	93%	19%
Under Logs	7%	2%	2%	13%
In Open	78%	30%	5%	68%
AGE				
1 yr. old	7%	92%	92%	7%
2 Yrs. "	14%		1%	5%
3 " "	79%	8%	7%	88%

PLATE NO. 53.

PROJECT - PRIEST RIVER - M-c-1.

General view of Fidelity cutting on Sec. 20, showing the conditions of the ground cover and the general lay of the land. As seen by the view, all of the seed trees when cutting was done have been blown down.

THE JOHNSON HOMESTEAD AREA

Location N.W.¼ Sec. 20, T. 57 N., R. 5 W., Boise M.

Topography General area level, rolling toward south end.

Soil Deep silt soil, well drained.

Condition before cutting Mature stands of white pine, cedar, larch, Douglas fir, hemlock, and grand fir. All in good condition and approximately of a 150 year age class.

Utilization All merchantable timber was cut and the remainder slashed.

Brush disposal All unmerchantable material slashed, cleared away from edge of timber and broadcast burned.

Silvicultural system Clear cut.

Burned-over Summer of 1906.

Seed years Some species seeding each year with a heavy crop of all species in 1909 and a fair crop in 1911.

This area has been lightly pastured since the burn of 1906 and has been in very good condition for reproduction as the mineral soil is exposed on a large percent of the area and the growth of grasses and weeds has not been heavy enough to interfere with the seedlings . Plots on this area are designated by the serial number 300.

Chart plots 301, 302 and 303 are taken on this area in some of the most favorable localities. These charts show that the seed trees have been seeding each year but the distance of seeding has been practically the same each year. Further out on the area there is no reproduction, so the chart shows the limits of seeding in the different directions from the seed trees.

CHART PLOTS.

Chart Plot No. 301

Size and location 1 chain wide along timber, by 2 chains long out from timber. At south side of Johnson homestead area.

Aspect 10% north slope.

Soil Deep silt, well drained.

Ground cover Patches of humus and duff around stumps and along a few scattered logs on the plot. Tufts of grass and individuals of fireweed, strawberry, thimbleberry, and bearberry. Mineral soil exposed on a largerpart of the area.

Direction from seed trees North.

Seed trees within one chain of plot 4 white pines 16 to 22 inches D.B.H., 2 cedars 18 and 20 inches D.B.H. 1 hemlock 16 inches D.B.H., 1 larch 25 inches D.B.H., 1 Douglas fir 14 inches D.B.H., all in good condition for seeding.

Light values Light readings showed light values of .1 at the edge of the timber where the reproduction

was good and .05 at a distance of ½ chain into the timber where the white pine reproduction stopped.

Chart XII shows the distribution of the seedlings on this plot.

PLOT NO. 301.

CHART 12 Scale 8 in. = 1 chain. Date. Sept. 28, 1912.

Edge of timber.

Chart plot No. 302.

Size and location — 1 chain wide along timber by 2 chains long out from timber. At west side of Johnson homestead area.

Aspect — 5% east slope.

Soil — Deep silt, well drained.

Ground cover — Scattering annuals and shrubs same as 301. Mineral soil exposed on a large part of the plot.

Direction from seed trees — East.

Seed trees within one chain of plot — 5 white pines 14 to 26 inches D.B.H., 1 cedar 16 inches D.B.H., 1 hemlock 15 inches D.B.H., 2 larches 16 and 26 inches D.B.H., 1 Douglas fir 18 inches D.B.H., and 1 grand fir 18 inches D.B.H. All healthy and in good condition for producting seed.

Light values — Value of .05 readings taken one chain into timber where white pine reproduction stopped.

Chart XIV shows the distribution of the seedlings on this plot.

Edge of timber

Chart plot No. 303.

Size and location 1 chain wide along timber by 2 chains long out from timber. At west side of Johnson homestead area.

Aspect Level.

Soil Deep silt, well drained.

Ground cover Same as 302.

Direction from seed trees East.

Seed trees within one chain of plot 6 white pines 14 to 26 inches D.B.H., 2 cedars 18 and 22 inches D.B.H., 2 hemlocks 14 and 16 inches D.B.H., 1 larch 20" D.B.H., 2 Douglas firs 15 and 18 inches D.B.H., and 1 grand fir 18 inches D.B.H. All good healthy trees.

Light values Value of .05, readings taken 3/4 chain into timber where white pine reproduction stopped.

Chart XIII shows the distribution of the seedlings on this plot.

Edge of timber

CONDITIONS UNDER WHICH SEEDLINGS WERE FOUND.

	White Pine	Cedar	Hemlock	Larch	Grand Fir
SOIL					
On Humus	3%	5%			9%
" Duff	18%	8%		14%	28%
" Wood Litter	20%	12%	90%	16%	8%
" Mineral Soil	59%	75%	10%	70%	55%
PROTECTION					
In Shade	2%	20%	60%	10%	15%
Under Logs	8%	12%	15%	6%	25%
In Open	90%	68%	25%	84%	60%
AGE					
1 yr. old	39%	20%	90%	20%	2%
2 yrs. "	7%	22%	10%	10%	4%
3 " "	17%	54%		50%	35%
4 " "	34%	4%		20%	50%
5 " "	3%				9%

PLATE NO. 54.

PROJECT - PRIEST RIVER - M-c-1.

View on plot 303 on Johnson homestead. White pine seedlings 1 to 5 years old in foreground. Thrifty stand of seed trees of White Pine, Cedar, Hemlock, Larch, Douglas Fir and Grand Fir in background. As seen here there is scarcely any ground cover to interfere with reproduction. Plots 301 and 302 are similar to this both in ground cover and forest stand of seed trees.

FIDELITY SALE SEC. 30.

Designation — Kaniksu - Fidelity Lumber Co., Oct. 21, 1911.

Location — Sec. 30, T. 57 N., R. 5 W., Boise M.

Topography — Small valleys and ridges generally northeasterly direction - some quite steep.

Soil — Moist sandy loam, no erosion.

Condition before cutting — Mature, thrifty stand before fire of 1910. Fire cause blue-stain in pine and caused a general attack of Dendroctonus monticola to the fire injured trees.

Reproduction — All reproduction was killed by the ground fire of 1910. Mineral soil was exposed and left the area in excellent condition for reseeding.

Utilization — All merchantable timber of white pine and cedar, living and dead, standing and down to be cut. When this examination was made in the fall of 1912 only the white pine had been removed and the cedar cutting was in progress.

Brush disposal — The white pine brush had been partially piled left unburned.

Silvicultural system — By removing the white pine and cedar only it virtually amounted to a selection system but the desirable species had been all cut so there would be no reseeding except the seed left on the ground at time of cutting.

Burned-over — During the extensive forest fires of 1910 a severe ground fire passed over this area with the results mentioned above.

Seed years — There was an extraordinary crop of seed produced in the fall of 1911, probably due to the stimulation of the trees by the fire injury of the previous season.

CONDITIONS BEFORE CUTTING.

	White Pine	Cedar
Average total height of trees	150'	80'
Average diam. of trees	20"	20"
Average stand feet B.M. per A.	11,000	2,350

A large percent of the stand on this area consists of larch and scattering hemlock and Douglas fir.

Seedlings on plots on this area were counted but not charted as all the seedlings are one year old and the seeding was done by seed trees standing on the plots so migration was

was not taken into account.

Plots on Sec. 30 designated by serial number 400.

Plot No. 401.

Size and location — Plot ½ chain square. Located 13 chains 10 degrees S. of W. from the fork in the logging road where the clump of white pine trees are marked with U.S.F.S. sale signs.

Aspect — 15% northeast slope.

Soil — Moist sandy loam.

Ground cover — Scattering individuals of thimbleberry and annuals. Mineralsoil exposed with patches of humus and duff.

Seed trees on plot — 3 white pine stumps 14 to 22 inches diameter (these trees seeded in 1911 and were cut during the winter of 1911-12), 3 larches 18 to 24 inches D.B.H., 2 cedars 16 and 20 inches D.B.H.

Light values — Readings taken at the crowns of the 1 yr. old seedlings gave value of .05.

Crown density of trees left standing — Varies from .5 to .7

Seedlings on plot all one year old — White pine 333, cedar 11, hemlock 1, Douglas fir 3. This would be 13,320 white pine, 440 cedar, 40 hemlock, and 120 Douglas fir per acre.

Plot No. 402

Size and location — ½ chain square. Located 5 chains 20 degrees E. of E. cg plot 401.

Aspect — Level.

Soil — Moist, sandy loam.

Ground cover — Same as 401 except that there is slash on about one-half of the plot.

Seed trees on plot — 1 white pine stump 28" diameter cut in 1911. 5 larches 16 to 30 inches D.B.H., 2 cedars 16 and 18 inches D.B.H., and 1 hemlock 20 inches D.B.H.

Light values — Readings taken at crowns of 1 yr. old seedlings value .04.

Crown density of trees left standing — From .6 to .8

Seedlings on plot all one year old — White pine 237, cedar 8, Douglas fir 11, making 9,480 white pine and 440 Douglas fir per acre.

Plot No. 403.

Size and location ½ chain square. 2 chains east of Plot 402.

Aspect 10% southeast slope.

Soil Moist, sandy loam.

Ground cover Same as 401.

Seed trees on plot 2 white pine stumps 18 and 24 inches diam., cut in 1911. 3 larches 18 to 30 inches D.B.H., 6 cedars 16 to 20 inches D.B.H.

Light values Readings at crowns of the 1 year old seedlings value .04.

Crown density of trees left standing From .6 to .8

Seedlings on plot all one year old White pine 269, cedar 9, Douglas fir 8, making 10,760 white pine, 360 cedar, and 320 Douglas fir per acre.

The seedlings on this area did not appear very thrifty and many of them were dead when this examination was made, due to too heavy shading.

PLATE NO. 55.

PROJECT - PRIEST RIVER - M-c-1.

View on plot 401/ Showing the slope, ground cover and standing timber left.

PLATE NO. 56.

PROJECT - PRIEST RIVER - M-c-1.

View on plot 402. Showing slash left on one side of the plot and dense stand of timber on the other side of the plot.

PLATE NO. 57.

PROJECT - PRIEST RIVER - M-c-1.

View on Section 22 on West Branch River showing where an open forest has been cut with good stand of reproduction established previous to cutting. Clump of reproduction on the left consisting of White Pine 3 to 12 years old, shows how well the area was covered before it was burned over in 1911. The fire killed all of the young growth and there is no reproduction now except in the unburned patches. An area like this left unburned would produce an excellent stand.

SUMMARY FOR ALL FIVE AREAS STUDIED.

CONDITIONS UNDER WHICH SEEDLINGS WERE FOUND.

AVERAGE OF ALL THE AREAS.

	White Pine	Cedar	Hemlock	Larch	Grand Fir
SOIL					
On Humus	3%	2%	7%	1%	9%
" Duff	34%	16%	19%	28%	26%
" Wood Litter	25%	22%	58%	17%	8%
" Mineral Soil	38%	60%	16%	50%	55%
PROTECTION					
In Shade	21%	54%	64%	22%	15%
Under Logs	8%	4%	8%	8%	25%
In Open	71%	42%	28%	70%	60%
AGE					
1 yr. old	57%	74%	87%	25%	2%
2 yrs. "	19%	9%	3%	11%	4%
3 " "	34%	16%	4%	55%	35%
4 " "	9%	1%	1%	9%	50%
5 " "	1%				9%

In regard to the areas examined the foregoing tabulation shows that the white pine seedlings start about equally well on the duff, wood litter, and mineral soil, but as shown previously in this report, the seedlings on the mineral soil are better established, due to the better root system. The small percent of humus is due to the scarcity of the humus covered soil. The seedlings apparently need little or no protection. The cedar and hemlock were found in the shaded places where moisture is plentiful. The cedar prefers the mineral soil, while the hemlock prefers the wood litter, usually starting on the old decayed logs where they are shaded and kept moist.

The table is self explanatory as to the conditions under which the different species were found.

As shown by the migration chart, the distance of seeding from the seed trees seldom exceeds two chains to any appreciable amount.

Under average conditions it is apparent that moisture is the chief factor which enables the seedling to establish itself.

The habitat of the seedlings found was generally similar to the conditions of the general area which indicates that no seed had been sown on the areas farther than shown by the migration charts.

PROJECT - PRIEST RIVER - F-n-1.

NURSERY PRACTICE - DISTRICT ONE.

OBJECT

To determine the best methods of conducting nursery work in the various nurseries of the District.

WORK DONE PRIOR TO DECEMBER 31, 1912

At the Experiment Station experiments have been conducted during the season along the following lines:

1. Various amounts of seed of different species to be sown in seed beds.
2. Time of sowing - spring or fall.
3. Broadcast sowing versus drill sowing in the seed beds.
4. Depth of covering of seed in the beds.

Some observations which can hardly be called experiments were made on the effect of fall heeling in and fall transplanting.

The other nurseries of the District have done more or less experimenting for their own purposes but nothing in co-operation with the Experiment Station nor correlated with the Investigative work of the District, with the exception of the work on Project F-s-4 in comparative germination in green house and field, together with a comparison of depth of covering.

1/ AMOUNT OF SEED TO SOW

In the late fall of 1911 two beds 4x12 were sown broadcast at the Benton Flat Nursery, one to Pinus ponderosa and one to Pinus monticola. The beds were carefully prepared and divided into three equal plots, four feet square. Three different amounts of each species were then sown, one amount on each plot, and covered ½ inch deep. Beds were given half shading during the season but no artificial water. Rains were well distributed throughout the summer, ranging from 2.14 inches in June to 2.67 in August. Table No. 1 shows the season's results:

Table No. 1.

Species	Pounds Sown: per plot	Pounds Sown: per bed	Germination: %	Germination: No.	Number Living: %	Number Living: No.	Number per Square foot: Germinated	Number per Square foot: Living
P. ponderosa	.66	2.0	21	635	19	623	40	39
" "	.83	2.5	34	1300	32	1253	81	78
" "	1.00	3.0	27	1222	25	1150	76	72
P. monticola	.33	1.0	16	777	15	752	48	47
" "	.50	1.5	8	628	7	560	39	35
" "	.66	2.0	8	748	6	622	47	39

COMMENTS

The P. ponderosa seed was large and poorly cleaned, containing 6,470 per pound original sample. This on a basis of the 70% green house tests contained 4,530 living seeds. The per cents

given in the above table are based on the latter figure. The fact that the germination in the different plots ranged from 21 to 34 per cent shows that conditions in the plots must have been different in moisture content or other important factors. The value of a comparison between the plots is therefore doubtful.

The germination of P. monticola is probably not yet complete and will be increased in the spring. The germination of P. ponderosa, which averages 27% of the total number of living seeds as shown by the green house test, is only one-half of the 56% obtained with the same seed in Project F-s-4, sown in May. This indicates that the conditions in the fall sown bed were particularly unfavorable, either because of the fall sowing or other causes. Assuming that under more favorable conditions a germination of 50% of green house test could be assured, this would give 140 per square foot when sown at three pounds per bed, the maximum tried in this experiment.

Opinions seem to differ as to what is the best density for broadcast yellow pine. At the Savenac Nursery, where large seed is used and large stock is raised, a density of 150 one year old seedlings per square foot reduced by loss to about 100 two year olds in the second year, is thought best. At the Boulder where smaller seed is used and smaller plants are raised, a density of 225 per square foot at the start and 150 per foot at the end of two years is considered most desirable. A density of 300 at the start and 200 at two years is thought to be good for white pine.

It is apparent that in this experiment too little seed was sown even in the case of the highest amount of three pounds per bed. The question resolves itself into one concerning the number of good seed sown per square foot rather than the number of pounds sown per bed, because different samples of yellow pine seed differ so widely in the number of seed per pound. The study of the amount of seed to sow per bed, therefore, becomes a study of the results produced by different densities. Given accurate germination figures and counts and with a good idea of the percentage of green house germination that can be expected in the nursery, a nurseryman can make the density almost whatever he desires. Consequently, the only additional information needed is the original density which on an average will produce the sturdiest and best plants for field planting at the lowest cost, chances of disease and accident being considered.

WORK PLANNED FOR 1913

Since the per cent of green house germination which can be expected in nursery beds seems to differ widely for each nursery, the matter of the number of seed to sow per square foot becomes a local problem in which this variable must be determined. This will be done in the work under Project F-s-4. A study of the relative value of different densities can, however, be carried on at the Experiment Station and results will be applicable to all of the nurseries in the District. This will be started during the coming summer in a carefully controlled experiment under good nursery conditions, using P. ponderosa,

P. monticola, and possibly Ps. taxifolia. One or two beds will be used for each species and divided into plots 4 feet square and as many different densities included as space permits, ranging from below accepted standards to considerably above. Some of this stock will be planted as 1-0, some as 2-0, and some transplanted and used as 1-1 and possibly 1-2 and 2-1, in the following years, in uniform field plots.

2. TIME OF SOWING - FALL OR SPRING

Pinus ponderosa and Pinus monticola were used in this experiment, one 4 x 12 bed at the Benton Flat Nursery being used for each. Each bed was prepared in the usual way and divided into six parts, 2 feet by 4 feet. Two sixths were sown in the fall, one broadcast and one in drills, with unsoaked seed; two sixths in the same way in the spring; and two sixths in the spring with seed soaked 48 hours, one broadcast and one drill. Seed was covered one half inch deep. No artificial watering was done and one half shade was used. The seasons' counts are shown in Table No. 2.

TABLE NO. 2.

Species Sown	Season	Method	Amount lbs.	Germination %	Germination Number	Number Oct. Living	Number Oct. dead	Average growth
P. ponderosa	Fall	Bdcst	.42	16	331	310	21	2½
" "	Spg	"	.42	31	602	586	16	2 3/4
" " soaked	Spg	"	.42	27	472	450	12	2 3/4
" "	Fall	Drill	.166	21	160	153	7	2½
" "	Spg	"	.166	19	145	128	17	2½
" " soaked	Spg	"	.166	26	200	186	14	2½
P. monticola	Fall	Bdcst	.25	10	358	343	15	1
" "	Spg	"	.25	2	80	75	5	3/4
" " soaked	Spg	"	.25	4	150	143	7	1
" "	Fall	Drill	.083	6	74	72	2	1
" "	Spg	"	.083	1	17	15	2	3/4
" " soaked	Spg	"	.083	3	38	35	3	1

COMMENTS

In the case of yellow pine the broadcast plots show a marked advantage in favor of dry spring sowing, the soaked spring sowing being somewhat less and the fall sowing only half. The drill plots give the advantage to soaked seed in the spring with fall sowing second and dry spring sowing third. The white pine plots show clearly the advantage of fall sowing over spring sowing. In the case of spring sowing the soaked seed produced over twice as many seedlings as the unsoaked, but the germination in both

cases was very small. Undoubtedly this will be considerably increased in the spring of 1913.

There is considerable variation in the germination secured in these three ways, but this may have been due partly to differences in moisture content or other factors as well as differences in season. Assuming, however, that the differences are largely due to season and soaking, the results indicate:

1. That yellow pine sown in the spring germinates slightly better than that sown in the fall.
2. That there is no essential difference in the germination of soaked and unsoaked yellow pine.
3. That fall sowing is better for white pine.
4. That soaking spring-sown white pine is mildly beneficial.

WORK PLANNED FOR 1913

One bed was sown in the new meadow nursery in October, 1912, with P. monticola. Observations will be made in 1913. Another bed will be sown in spring with lots stimulated in different ways.

BROADCAST SOWING VERSUS DRILL SOWING IN THE SEED BEDS

WORK DONE PRIOR TO DECEMBER 31, 1912

The work done in the foregoing experiment in fall versus spring sowing was also made to show differences between drill and

broadcast sowing, all seasonal plots being sowed both broadcast and in drills six inches apart. Table No. 2 shows the comparative value of the two methods.

As noted in the previous experiment, differences in moisture content, due to lack of frequent artificial watering, which would tend to make the end plots of the bed drier than the center ones, is probably a partial cause of the differences in germination shown. Assuming, however, that the moisture content is a minor factor, the results indicate:

1. That there is practically no difference between broadcast and drill sowing of yellow pine.
2. That broadcast sowing of white pine has a slight advantage over drill sowing.

WORK PLANNED FOR 1913

Most of the nurseries of District II favor drill sowing while the nurseries of District I claim to get best results by broadcasting. The two methods involve differences in cost and quality of stock and the matter should be determined for each nursery in the District. Experiments which will run two years will be started in the spring at each nursery and closely observed, using yellow pine, Douglas fir and possibly white pine.

4. DEPTH OF COVERING OF SEED IN THE BEDS

Two 4 x 12 beds at the Benton Flat Nursery were sown in the fall of 1911, one with Pinus monticola and one with Pinus ponderosa. Each bed was divided into six plots, 2 feet by 4 feet

and sown in drills six inches apart, the seed in each plot being covered to a different depth, ranging from ¼ inch to 1½ inches. The beds received no artificial watering and were given half shade during the season. Table No. 3 shows results of the 1912 season:

Table No. 3.

Species Sown	Depth Covered	Amount lbs.	Germination %	Germination Number	Number Oct. Living	Number Oct. Dead	Average growth
Pinus ponderosa	1/8"	.166	26	195	180	15	2"
" "	¼ "	.166	31	236	232	4	2"
" "	⅜" "	.166	31	237	228	9	2¼"
" "	3/4"	.166	26	191	176	15	2⅛"
" "	1 "	.166	45	344	336	8	2¼"
" "	1½ "	.166	12	91	78	13	2⅛"
Pinus monticola	1/8"	.083	2.2	27	24	3	1"
" "	¼ "	.083	1.6	20	25	5	1"
" "	⅜ "	.083	1.4	18	24	6	1"
" "	3/4"	.083	2.2	26	30	4	1"
" "	1 "	.083	2.6	37	34	1	1"
" "	1½ "	.083	2.3	28	32	4	1"

Germination of the white pine will be largely increased next spring so that no conclusions can be drawn at present. The yellow pine results were probably affected by difference in moisture content in the different plots, those inside having the advantage over those at the ends, making the value of a comparison

doubtful. The advantage in favor of 1 inch depth is probably due more to adverse conditions on the other plots than to depth of covering.

Under Project F-s-4, comparative germination in the green house and field, some comparisons were made in depth of covering in a similar experiment at three nurseries. Table No. 4 shows the results obtained.

In every case, the earliest germination was secured with the least depth. In the 30 days following the first germination there was very little difference, with a slightly larger germination in the case of the greater depth except with yellow pine. In the total amount of germination, three species show more with the shallow depth, one shows no difference, and two slightly favor the deeper covering. In general, the shallower depths are just as good or more favorable for all species, ½" for yellow pine, and ¾" for larch, white pine, lodgepole, Norway pine, and Douglas fir. This is subject, of course, to revision later.

WORK PLANNED FOR 1913

One bed was sown to white pine at five different depths from ½ inch to 3/4 inch, varying 1/5 inch, at the new meadow nursery at the Experiment Station in October, 1912. Further work with the other species will be started in the spring at the different nurseries according to a working plan to be drawn up later this winter.

TABLE NO. 4

Depth of Covering Seed in Nursery Beds.

Number of Test	Species	Depth of Cover: Inches	Number days before first germination: Savenac	P.R.	Boulder	Average	Best Depth	Percent of total germination In 30 days after first sprouting: Savenac	P.R.	Boulder	Average	Best Depth	Total germination in the nursery beds during season: Savenac	P.R.	Boulder	Average	Best Depth	Best depths on all points
1a	Pinus ponderosa	½	15	25	19	20	½	59	77	70	69	½	49	41	27	39	½	½
1b	" "	3/4	19	25	19	21		58	78	70	68		48	41	26	38		
2a	Larix occidentalis	¼	19	35	19	24	¼	57	96	92	82		28	9	5	14	¼	¼
2b	" "	½	19	34	31	28		73	98	82	84	½	13	11	6	10		
3a	Pinus monticola	¼	27	35	30	30	¼	25	43	46	38		6	5	5	5	?	?
3b	" "	½	17	34	43	31		24	52	52	43	½	8	4	4	5	?	?
4a	Pinus contorta	¼	15	25	19	20	¼	86	93	85	88		58	44	36	46		
4b	" "	½	20	29	29	26		91	96	80	89	½	58	46	37	47	½	½ (?)
5a	Pinus resinosa	¼	25	29	28	27	¼	75	86	97	86		76	74	35	62		
5b	" "	½	30	35	28	31		78	97	98	88	½	73	72	66	70	½	½ (?)
6a	Pseudotsuga taxifolia	¼	30	25	19	21	¼	81	83	90	85		64	60	44	56	¼	¼
6b	" "	½	20	30	22	24		80	90	93	88	½	60	49	49	53		

FALL HEELING IN

Stock left over from the planting operations in the fall of 1911 was heeled in over winter at the Benton Flat Nursery and then transplanted to the transplant beds in May. Less than half this heeled in stock lived while more than 75% of the stock planted in the fall survived, indicating that the heeling in over winter was harmful to the plants.

FALL TRANSPLANTING

Douglas fir 2-1 and yellow pine 1-1 stock left over from the source of seed experiments were set out in the transplant beds in October 1911. Little rain fell in October and the soil was quite dry at time of transplanting. Only about five per cent of transplants lived and the plots which were planted with the same stock at about the same time had to be almost entirely re-planted in the spring. The stock used was larger than usually transplanted and the conditions were abnormal because the lack of moisture in October, which is usually a wet month, so that the work could not furnish information of much value as to the advisability of fall transplanting at nurseries.

WORK IN NURSERY PRACTICE PLANNED FOR 1913

In September, 1912, an outline was prepared by the Experiment Station covering 16 different lines of investigation in nursery practice. This was submitted to the Office of Planting in the District Office and copies were sent to the principal

nurseries in the District.

After discussing the question as to what experiments had best be conducted at the Experiment Station and at each of the nurseries, the following distribution of experiments has been decided upon:

1. Amount of seed to sow per bed to secure greatest production of vigorous seedlings.
   Savenac
   Boulder

2. Best season and best part of the season to sow seed.
   Savenac
   Boulder

3. Depth of covering for different sizes and species of seed.
   Experiment Station
   Trapper Creek

4. Broadcast versus drill sowing in the seed bed.
   Savenac
   Boulder
   Trapper Creek
   Experiment Station
   (At nurseries, particularly for root pruning in bed.)

5. Methods of preparing beds by cultivation, manuring, etc. so as to produce maximum number of vigorous seedlings
   Savenac
   Boulder
   Experiment Station

6. Advantages and application of commercial fertilizers.
   Savenac
   Boulder

7. Mulching seed and transplant beds.
   Savenac
   Boulder

8. Cultivation versus watering of seed and transplant beds.
   Experiment Station

9. Amounts and intervals of watering seed beds.
   Savenac
   Boulder
   Experiment Station

10. Treatment of soil against "damping off."
Savenac
Boulder

11. Value of rotation in the nursery.
Savenac
Boulder
Experiment Station

12. Desirability and methods of root pruning.
Trapper Creek
Experiment Station

13. Preparation of beds so as to check the development of tap roots and increase the fibrous lateral roots.
Experiment Station
Michigan
Trapper Creek

14. Best season and best part of the season for transplanting.
Savenac
Boulder
Trapper Creek

15. Heeling in or storage of seedlings in fall for spring planting.
Savenac
Boulder

16. Proper degree of shading for different species.
Savenac
Boulder
Experiment Station

Some time before the season opens a tentative working plan will be prepared by the Experiment Station for the work to be conducted at each of the nurseries. This will be submitted to the men in charge of the nurseries for their suggestions and recommendations and if possible one of the men at the Station will visit the different nurseries and look over the ground in person, after which a final plan will be prepared and the experiments started. It may not be practicable to start experiments along all of the different lines of work in the outline during 1913 and in such a case preference will be given to those of most

immediate importance.

COSTS

The cost of clearing the nursery areas and of screens, frames and lath shades has been charged against nursery investigations in our cost-keeping. The cost therefore appears high considering the amount of work accomplished but in the future it will be proportionately reduced because of the small amount of further improvement work needed.

Cost up to December 31, 1912----------$327.03
Estimated cost for 1913---------- 150.00
Further cost to completion---------- ?

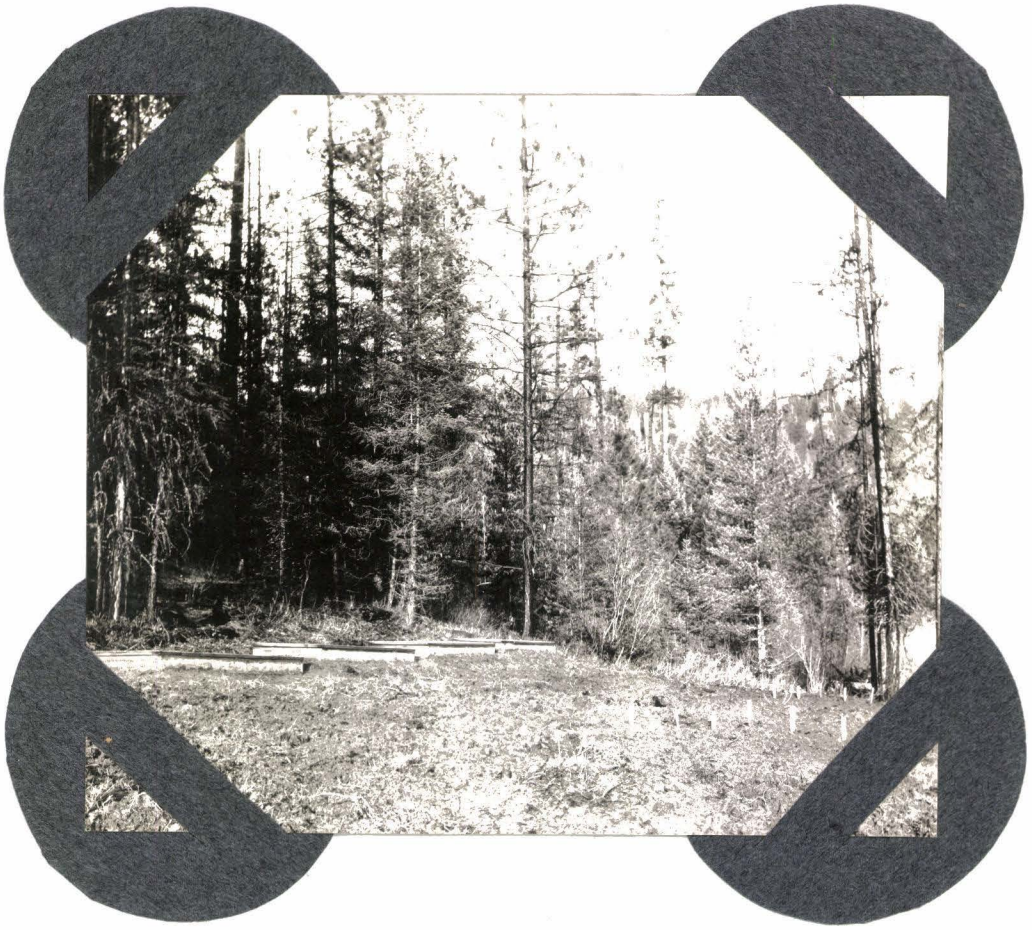


PLATE NO. 33

Project F-n-1--Nursery Practice.

Shows corner of new nursery near meadow on gentle south slope. The four coniferous beds sown this fall are shown on the left and six rows of hardwoods (nuts and acorns) are indicated by the stakes on the right. Terracing of the beds indicates degree of slope. 50 year stand of white pine, larch and cedar in background.

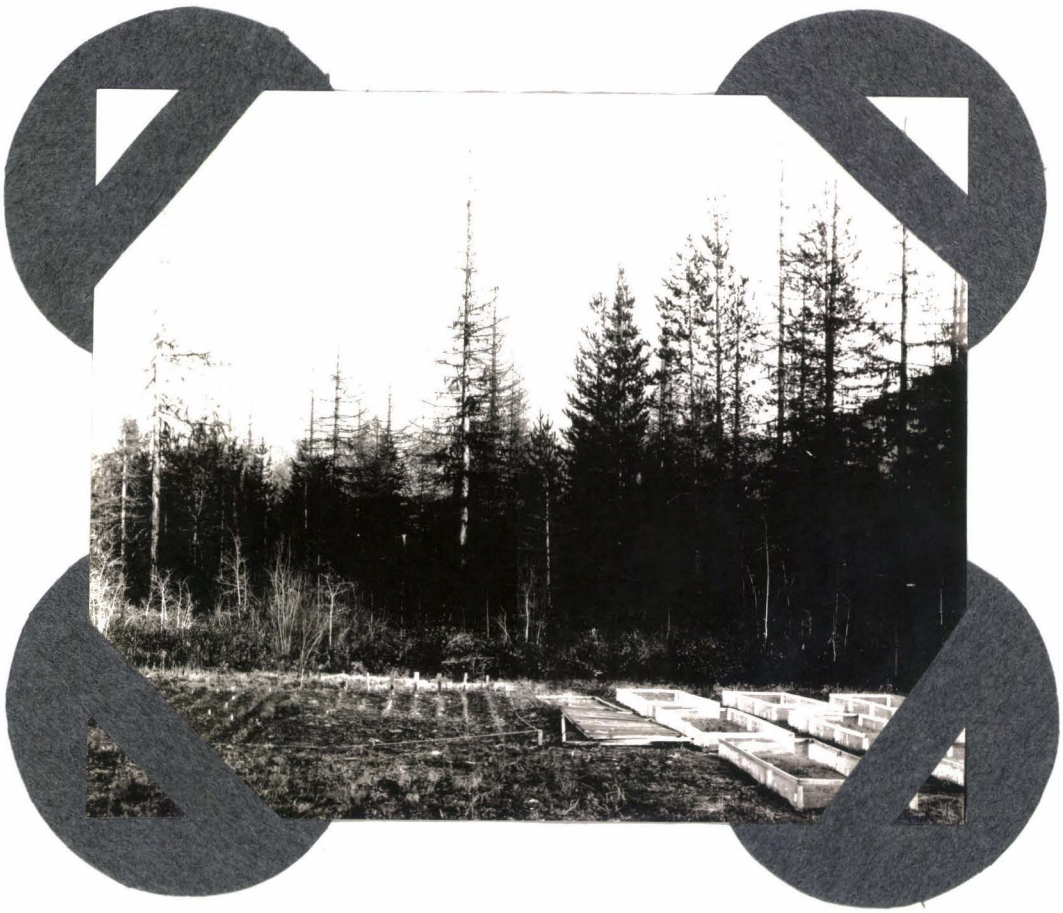


PLATE NO. 34.

Project F-no 1, Nursery on Block A, Benton Flat.

Shows 4x12 nursery beds on right, protected by ½" mesh wire screens. Lath shade frames in center. Rows of transplants on right.